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Community Level Factors and HIV among Marginalized Populations in the United States

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An abstract of
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Abstract

Community Level Factors and HIV among Marginalized Populations in the United States

By Matthew J. Page

Men who have sex with men (MSM) and black women are two groups most adversely affected by HIV in the United States. Prior research has shown that the HIV disparity between black and white women is not driven solely by differences in individual risk behaviors. In addition, there is a paucity of effective behavioral interventions aimed at MSM. Perhaps more potent community level exposures exist that may be more amendable to effective preventive interventions than are individual level exposures. In light of this, my dissertation aimed to answer three research questions:

1. Is the community sex ratio associated with HIV status among black women?
2. Is perceived discrimination against gay and bisexual men associated with HIV status among MSM?
3. Is structural discrimination against gay and bisexual men associated with HIV status among MSM?

For the first question, I developed multilevel models to evaluate the association between HIV status and six versions of the sex ratio among black female respondents in 29 counties covered by the heterosexual National HIV Behavioral Surveillance System (NHBS-HET1) conducted in 2006-07. The odds ratio (OR) for the final overall sex ratio (all ages and races/ethnicities) was 0.98 (95% CI: 0.94-1.01). This trend of near null values with borderline statistical significance was maintained across the remaining models.

To answer the second question, multilevel models were run to assess the association between perceived discrimination against gay and bisexual with HIV status among MSM in 18 areas covered by NHBS-MSM2 conducted in 2008. The OR for overall perceived discrimination was 1.0 (95% CI: 0.96-1.04). The results for partial perceived discrimination were similar.

For the final question, multilevel models were developed to evaluate the association of three measures of structural discrimination – overall structural discrimination; recognition of same-sex partnerships; and prohibition of same-sex marriage – against gay and bisexual men with individual level HIV status among MSM residing in 20 NHBS-MSM2 areas. The main finding from this study is that the association between same-sex marriage prohibitions and HIV status was positive and significant (OR=1.24 (95% CI: 1.05-1.47)) for non-Hispanic white MSM.

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Regardless of what I have accomplished at Emory and will accomplish afterwards, the decision to join the Department of Epidemiology led to the greatest fortune of my life –

meeting my wife, Missy. Her love and support have gotten me to this point. If what I give her is half of what she gives me, I will be happy.

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CHAPTER 1

Introduction

This chapter provides an introduction to the research areas of interest for my dissertation research. The chapter begins with an overview of disparities in HIV incidence and prevalence among black women relative to white women and among men who have sex with men (MSM) relative to men who have sex only with women (MSW). The next section explores social determinants of population health in general and of HIV in particular. Following this is a discussion of social marginalization as a form of social determinant and then a review of the types of marginalization examined as part of my dissertation research – an imbalanced community sex ratio, perceived discrimination against MSM, and structural discrimination against MSM. The final section of the chapter lays out my specific dissertation research questions.

DISPARITIES IN HIV INCIDENCE AND PREVALENCE

Disparities in the incidence and prevalence of HIV occur in several population subgroups. Two of the starkest disparities occur in African American, or black, women relative to women of other races, especially white women, and MSM relative to MSW. These disparities are discussed in detail below.

Black Women

As early as 1987, researchers noted a rate of human T-lymphotropic virus/lymphadenopathy-associated virus (HTLV-III/LAV) among the black population that was three times greater than among whites (1). This research also noted a greater prevalence of Acquired Immunodeficiency Syndrome (AIDS) among the black heterosexual population (1). In 2008, 51.5% of all new HIV diagnoses among those ages 13 years and older in the US occurred among black men and women (2). This translates to a rate of 73.7 diagnoses per 100,000 people – nine times the rate of new diagnoses among whites (8.2 per 100,000) (2).

A recent study estimated HIV incidence in the US using surveillance data from 16 states and two cities and a modified, stratified extrapolation method based on a sample survey approach with multiple imputation, stratification, and extrapolation to account for missing data and heterogeneity of HIV testing behavior among population (3). Based on data from this study, the HIV incidence rate ratio of blacks relative to whites was 7.42 in 2006; 7.07 in 2007; 8.41 in 2008; and 7.68 in 2009 (3). In a study of HIV prevalence conducted in 2006-07 in urban areas of 24 Metropolitan Statistical Areas (MSAs) with high AIDS prevalence, the HIV prevalence ratio of whites relative to blacks was 0.5 (4). This difference was statistically significant (4).

Despite relatively similar percentages in terms of heterosexual transmission and greater transmission via injection drug use (IDU) among white women, black women accounted for 66.7% of new HIV diagnoses among women in 2008 (2). Of all new diagnoses of heterosexually transmitted HIV among women in 2008, 63.8% were in black women and

18.8% in white women (2). Of women who contracted HIV through heterosexual contact living in 2007, 63.5% were black while only, 18.6% were white (2).

Men Who Have Sex with Men

MSM continue to be disproportionately affected by HIV and AIDS. In fact, since 2000, MSM have been the only identified risk group in the US in which HIV incidence was increasing (5). This increase is part of a broader international trend of increasing rates of HIV diagnoses among MSM in North America, Western Europe, and Australia (6). In one study, 55.6% of all new diagnoses among men and women in the US in 2006 were due to male-to-male sexual contact (3). This percentage of new HIV diagnoses in the US due to male-to-male sexual contact was 57.7% in 2007; 56.3% in 2008; and 60.9% in 2009 (3). According to national surveillance in the US, of all new diagnoses of HIV infection among both men and women estimated to have occurred in 2008, 54.4% were estimated to be due to male-to-male sexual contact (2).

Among males ages 13 and older for whom a mode of transmission was identified, 73% of new HIV diagnoses in 2008 were due to sexual contact with other men (2). In comparison, 8.3% were due to IDU and 14.6% were due to heterosexual contact (2). Of all new AIDS diagnoses among males in the US in 2008, 51% were due to male-to-male sexual contact (2). Of males living with HIV in 2007, 53.1% contracted the disease through male-to-male sexual contact (2).

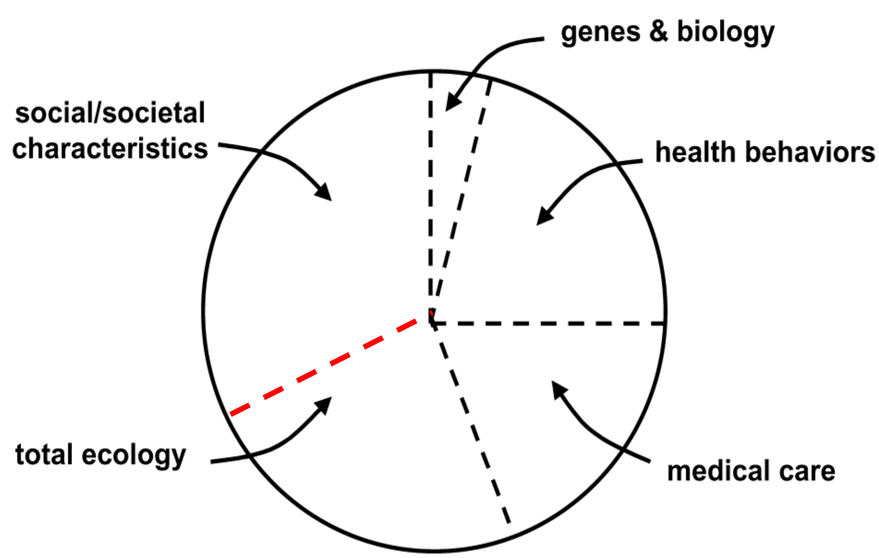
Despite MSM continuing to be disproportionately affected by HIV and AIDS, there remains a dearth of behavioral interventions proven to be effective at reducing the risk of HIV acquisition among MSM. Of 29 HIV prevention interventions directed at HIV-negative persons that have been labeled as showing “best evidence” of effectiveness by the Centers for Disease Control and Prevention (CDC), three (10.3%) have been demonstrated effective among MSM (7). That is, a US subpopulation that is estimated to account for more than 50% all new annual diagnoses of HIV is effectively served by 10% of “best evidence” prevention interventions.

This lack of effective behavioral interventions is one of the main motivations for identifying and developing potential community level interventions. Interventions that aim to address structural and community factors offer a possible alternative to individual level behavioral interventions. Developing such alternative interventions provides a tremendous opportunity to reduce the large number of newly diagnosed HIV infections occurring annually among MSM as well as other adversely affected subpopulations (8) in the US. An important component of developing alternative interventions is identifying and assessing societal and structural factors associated with prevalent HIV infection that may be amenable to intervention. Identifying and assessing such societal and structural factors is the main focus of my dissertation research.

SOCIAL DETERMINANTS OF HEALTH

Tarlov has identified five determinants of population health – (1) genes and biology, (2) health behaviors, (3)medical care, (4) social/societal characteristics, and (5) total ecology (Figure 1) (9). Although the five groups of determinants interact in determining the course of population health, some have greater relative influence on population health than others. Health behaviors, the category to which the proximate causes of HIV are most closely linked, have greater influence than medical care and genes and biology but may have substantially less influence than societal characteristics and the total ecology, the category to which the distal causes of HIV infection are most closely linked (9). Figure 1 represents the contribution of each determinant to population health in general.

Figure 1. Five Determinants of Population Health and Their Relative Influences (adapted from (9))



The social and societal characteristics that influence population health are collectively referred to as the social determinants of health (10). Several theories have been proposed to explain the link between social determinants and health outcomes. Ansari and colleagues have incorporated three of these theories – the material, psychosocial, and neo-material – into a holistic framework that depicts the interrelationships among the various groups of social determinants (10). The material theory holds that an individual's absolute social position has the greatest impact on health status (10, 11). According to the psychosocial theory, relative social position and the psychosocial factors related to the perception of this relative status is the most influential determinant of health (10, 12). The neo-material theory maintains that an individual's health status is determined by a combination of negative exposures, lack of resources possessed by individuals, and "systematic underinvestment across a wide range of human, cultural, and political-economic processes (10, 13)." The social determinants of health framework based on these three theories accounts for socioeconomic determinants, psychosocial risk factors, and community and social characteristics (10). Such a framework can be applied to a number of diseases and health outcomes, including HIV.

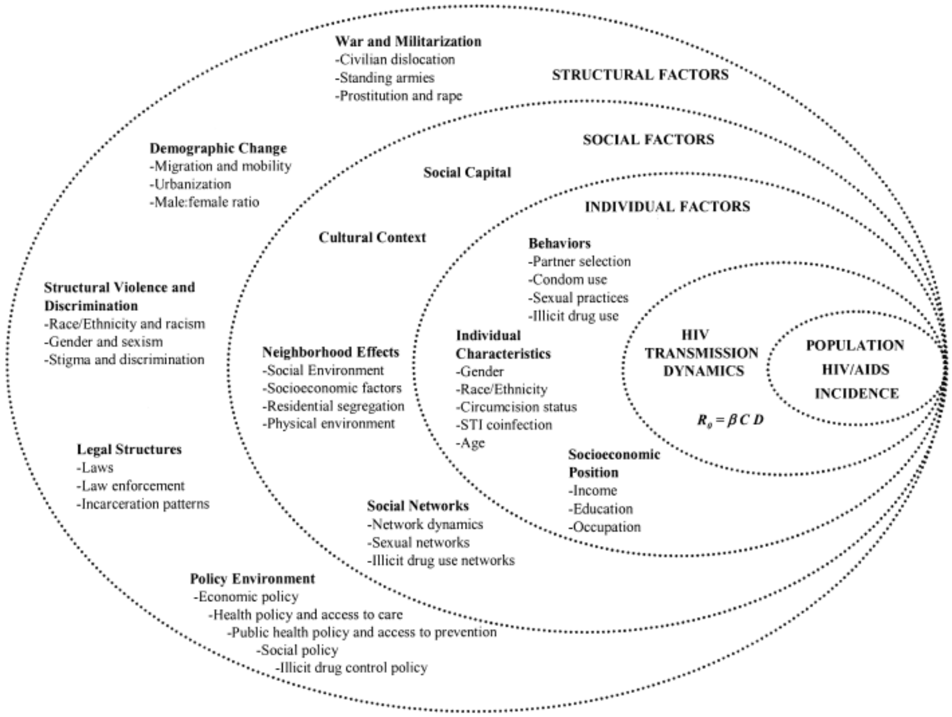
SOCIAL DETERMINANTS OF HIV

The HIV epidemic in the US is centered on specific geographic areas, especially urban areas in the Northeast and South and on the West Coast (14). Within these areas, even smaller enclaves are disproportionately affected (14). The risk among the populations of these smaller enclaves is “attributable in greater part to their vulnerable social and economic situations than to their own risky behaviors (14).”

Poundstone and colleagues have identified four categories of social-level factors that influence HIV transmission – (1) cultural context, (2) social networks, (3) neighborhood effects, and (4) social capital (15). Whereas cultural context refers to the general social environment and its influence on HIV, social networks can affect HIV transmission in several ways, including social influence, social engagement and participation, prevalence of HIV and network member mixing (either sexually or sharing needles for injecting drugs), access to material goods and informational resources, and social support (15). Neighborhood effects characterize the interrelationship among social networks and physical locations (15). Neighborhood effects can have both direct and indirect impacts on HIV transmission. Direct mechanisms, which increase an individual’s vulnerability to HIV infection, include residential segregation and social isolation of marginalized groups (15). Indirect mechanisms which affect population susceptibility to HIV include poverty and high unemployment (15).

The basic reproductive number of HIV (R_0) is calculated as a combination of transmission efficiency (β), contact rate (C), and duration of infectiousness (D). As detailed in Figure 2, several factors, including social networks and neighborhood effects, can affect R_0 and the continued transmission of HIV. Factors that could influence transmission efficiency include condom use, certain sexual practices, and the presence of specific coinfections (15). All of these are affected, to at least some degree, by neighborhood effects and other social and societal factors. Factors that may influence the contact rate are even more closely linked with social and societal factors, including the number of sex partners, the rate of sex partner acquisition, timing of sexual partnerships, and mixing patterns (15). Finally, duration of infectiousness is directly linked to one of Tarlov's five determinants of population health – medical care (9, 15). The first step in reducing HIV infectivity is diagnosis. Once a diagnosis of HIV has been rendered, the timeliness and quality of medical care are essential to limiting infectivity.

Figure 2. Heuristic Framework for the Social Epidemiology of HIV (15)



Social Marginalization

Marginalization is defined as "the process through which individuals or groups are peripheralized on the basis of their identities, associations, experiences, and environments (16)." Marginalization results in vulnerable populations who are at greater risk for adverse health outcomes, including HIV (16). Many, if not most or all, of the factors identified in Figure 2 occur more frequently in subpopulations that are socially marginalized. El-Sadr and colleagues note that HIV transmission in the US is characterized by "low prevalence in the general population [and] high prevalence among the disenfranchised and socially marginalized (14)."

The motivations for marginalization are vast and varied. Under the concept of "reciprocal exchange," whole classes of people are excluded from full community membership because of their perceived inability to contribute meaningfully to society or to reciprocate what they receive from society's collective representative, the government (17). Individuals receive social resources such as healthcare, welfare, and education with the understanding that they will reciprocate (frequently via taxation) at some point in the future (17). To limit the sharing of finite societal resources, the majority group may exclude, either implicitly or explicitly, certain minority groups who are perceived to be – or stigmatized as – poor reciprocators (17). This tendency toward exclusion may be heightened during times when social resources are scarce or perceived to be so.

The process of reciprocal exchange can be seen as originating in the economic sphere and extending to the social, cultural, and political spheres. Some groups, often defined by race or ethnicity, are viewed as "better" societal investments than others (17). Groups identified as good investments will receive needed resources and may eventually be assimilated into the majority group. Different European populations that immigrated to the US in the eighteenth and early nineteenth centuries are good examples of minority groups that eventually achieved assimilation. Almost 150 years after the end of slavery, black men and women in the US have continuously and consistently been excluded through various means, including sharecropping arrangements in the wake of slavery, Jim Crow, "separate but equal" educational systems, and residential segregation. As a result, they have yet to achieve anything close to assimilation into the majority population.

While social value is often predicated on a person's or group's ability to contribute to, or reciprocate the receipt of, societal resources, there are other motivations for exclusion. According to Vasas, "social exclusion refers to the norms and processes that prevent certain groups from equal and effective participation in the social, economic, cultural, and political life of societies (16)." In fact, minority groups can be marginalized on the basis of multiple characteristics (16, 17). A key component of such marginalization is stigmatization. "Stigmatized individuals possess (or are believed to possess) some attribute, or characteristic, that conveys a social identity that is devalued in a particular social context (18, 19)."

Stigma occurs when four components intersect (18). First, people single out and mark differences among groups or individuals (18). Second, dominant cultural beliefs associate labeled persons with characteristics deemed by the majority group to be undesirable (18). Next, persons linked to the undesirable characteristic are placed in discrete groups to facilitate "some degree of separation of 'us' vs. 'them' (18)." Finally, stigmatization depends on access to social, economic, and political power, which facilitates differentiating across population groups, developing stereotypes, separating labeled persons into distinct categories, and fully executing disapproval, rejection, exclusion, and discrimination (18). While some groups may be stigmatized based on sensibilities and perceptions emanating from historic economic motivations, others may be stigmatized and subsequently marginalized based on the majority group's moral and religious sensibilities regardless of the minority group's ability to contribute monetarily to society as a whole (16, 18). One example of a minority group marginalized based on non-economic motives is gay and bisexual men.

Stigmatization and subsequent marginalization have led to disparities in health outcomes, including HIV infection, between the vulnerable, or disadvantaged, groups on the one hand and the more advantaged groups on the other (9, 10, 16). As noted above, disparities in the occurrence of HIV occur along several axes. Black women and MSM are two of the groups most adversely affected. Determining what factors are truly driving the HIV epidemics among black women and MSM will allow for the most efficient targeting of finite prevention resources.

Marginalization and HIV

Black Women, Marginalization, and HIV

Previous research has shown that the disparity in HIV prevalence between black and white women is not driven solely by differences in individual level risk behaviors (20-25). Accordingly, several studies have hypothesized a link between certain forms of marginalization and HIV risk among black women (14, 21, 26-42). One specific way in which black women are marginalized is an imbalanced community sex ratio.

Racism

Underlying all marginalization of black men and women in the US is racism. In most ways, race is a purely arbitrary social construct used by the majority group as a tool of marginalization (26). In the US, the white majority group has always occupied the top rank of the socioeconomic hierarchy while, dating back to the time of slavery, blacks have always occupied the lowest rank (43). Racism precipitates prejudice, which in turn begets discrimination, contributing to what is referred to by sociologists as a "racialized social system (32, 44)." A racialized social system, defined as a "society where part of the stratification system is designed to rank people based on their racial classification (32)," is perhaps the most prominent form of marginalization in the US.

A main component of a racialized social system is the marginalization and limitation of the socioeconomic attainment of minority group members (34, 35). The controlled group's full participation in society is restricted (15). Discrimination, prejudice, and racism that drive and are propagated by the racialized social system in the US directly affect minority access to employment, educational, and housing opportunities, and, directly and indirectly, their health outcomes.

Community Sex Ratio

One consequence of racism and residential segregation that may be of direct relevance to the transmission of HIV is an imbalanced community sex ratio. Residential segregation and other forms of black community dislocation such as imprisonment, unemployment, and high mortality rates have rearranged the normal patterns of dating as well as marriage and family dynamics in black communities (32). This has been associated with a decrease in the male-to-female sex ratio in many black communities. The decline in the black sex ratio is entwined with an increase in the rates of crime and incarceration in black communities (21, 27, 33, 45, 46). During the 1960s and early 1970s in the US, a precipitous decline in the black community sex ratio preceded an increase in violent crime rates among black men (45). This imbalance has continued to present day (33, 45, 47).

An imbalanced sex ratio may lead some women to partner sexually with men whom they would not consider if the sex ratio were more balanced (32, 33, 47). While several authors have hypothesized a link between the community sex ratio and sexual risk behaviors, few have attempted to quantify this link (21, 32, 33, 40, 47-51). While some prior studies have linked the male-to-female sex ratio to STD rates, no studies have assessed the link between an imbalanced community sex ratio and HIV status at the individual level (47, 52-54).

Senn and colleagues performed a multilevel analysis to explore the association between the community sex ratio and multiple sexual partners among black patients of an STD clinic in upstate New York (47). In addition to their sex, race, and other personal characteristics, respondents were asked to report the number of male and female sexual partners they had in their lifetimes as well as in the previous three months; the number of unprotected vaginal and anal sexual episodes in the same timeframes; and the number of times they had exchanged sex for drugs or money in their lifetimes (47). In this study, the mean census tract-level sex ratio was 78.6 men for every 100 women (47). Men were more likely to report multiple sexual partners in the past three months (82% vs. 58%) and the number of sexual partners was higher among men (3.2) than among women (2.5) (47). A greater proportion of women (36%) reported exchanging sex for money or drugs than men (16%) (47).

The authors ran several multilevel models to test the association of individual and census tract level independent variables with the number of opposite-sex sexual partners in the previous three months as the dependent variable. In the model containing only the census tract sex ratio as a predictor, there was no association with the number of sex partners in the prior three months (47). In a model containing only an individual level measure of gender, there was an association between gender and number of sexual partners in the last three months, with men having significantly more partners than women (47). A third model containing gender, the census tract sex ratio, and the relevant two-way interaction term found that only the interaction term was significantly associated with the number of sex partners (47). Interestingly, while census tract sex ratio was associated with a small but insignificant decrease in the number of sex partners among men, it was associated with a significant increase in the number of sex partners among women (47). The authors note, however, that this association was likely driven by women who exchanged sex for drugs or money (47). Their hypothesis is that more men in a census tract mean more potential clients while fewer men would mean more difficulty in attracting men as potential clients.

In a more recent study, Pouget and colleagues explored the association of the sex ratio and male incarceration rates with multiple opposite-sex partners across the US (33). Utilizing data from the National Health and Nutritional Survey (NHANES) 1999-2004, this study examined the associations of male shortages and high incarceration rates with the number of opposite-sex partners (33). For their analyses, the authors calculated two community sex ratios – a “matched” ratio using population data on county residents of the same race/ethnicity as the participant and a “disassortative” ratio using population data on county residents of a different race/ethnicity as the participant (33).

Results were calculated for non-Hispanic black, non-Hispanic white, and Mexican American respondents. The disassortative sex ratio, calculated using population data on county residents of a racial/ethnic group other than that of the participant, was roughly 100 for all groups (101.8 for non-Hispanic blacks, 100.8 for non-Hispanic whites, and 100.3 for Mexican Americans) (33). The matched ratio exhibited wider variability – 84.8

among blacks, 99.5 among whites, and 113.1 among Mexican Americans (33). An even wider range was evident in the matched male correctional facility rate, which is the number of men in correctional facilities per 10,000 persons of the race/ethnicity of the participant in the county of residence. This rate was substantially higher among blacks (565.5) than among both whites (94.4) and Mexican Americans (172.0) (33).

Logistic regressions were run to calculate the odds of having multiple sex partners in the prior year. The association between multiple sex partners and two community sex ratios or the correctional facility rate was strongest among non-Hispanic black men (33). Black men in counties with a shortage of black men as well as high incarceration rates among black men were more likely to have multiple opposite-sex sexual partners than black men in countries with more balanced sex ratios (33). An imbalanced sex ratio and rates of incarceration were also found to be associated with having five or more sexual partners, an indicator of central position in sexual networks (33).

My dissertation research will build on the existing work by exploring the association of measures of the community sex ratio with HIV status rather than with sexual risk behaviors.

<u>MSM, Marginalization, and HIV</u>

An October 2006 study reported a total of 8.8 million gay, lesbian, and bisexual persons in the US (55). This population in general and MSM in particular experience marginalization along several axes (56-67). Two fundamental ways in which the marginalization of MSM is manifested are structural discrimination as well as intolerance on the part of the majority heterosexual community.

Structural Discrimination against MSM

Structural discrimination against gays and lesbians in the US has taken several forms. Through the early twentieth century, those professing a sexual attraction to those of the same sex feared the possibility of institutionalization (57). Same-sex sexual acts were criminalized in many states until relatively late in the twentieth century (57, 58). There is evidence of discrimination against same-sex couples in federal and state laws regulating child custody and parental rights (57). In certain instances, laws and regulations result in unequal treatment of gays or lesbians who attempt adoption (57). Structural discrimination in different forms has also been linked with mental health issues among gay men and lesbians (68, 69)

In response to this structural discrimination, six rights that should be extended to gays and lesbians have been enumerated (57):

1. The right to military service.
2. The right to be protected against violence.
3. The right to have consensual adult sexual relations without criminal penalty.
4. The right to marriage and/or legal and social benefits of marriage.

5. The right to retain custody of children and/or to adopt.
6. The right to be free from discrimination in housing, employment, and education, with an exception for religious organizations only.

At least one of these rights – the right to marriage – has been linked to HIV risk (60, 70, 71). Gates reported a total of 776,943 same-sex couples and 413,095 male same-sex couples in the US in 2005 (55). The vast majority of these partnerships are not officially recognized by the states or municipalities in which these couples reside. As of November 2011, six states (Connecticut, Iowa, Massachusetts, New Hampshire, and New York, Vermont) and the District of Columbia sanctioned same-sex marriage (62, 72). As of January 2012, same-sex civil unions were recognized in Delaware, Hawaii, Illinois, New Jersey, and Rhode Island (73). While California, Nevada, Oregon, and Washington offered broad same-sex domestic partner laws as of November 2011, Colorado, Maine, Maryland, and Wisconsin offered limited statewide spousal rights to same-sex couples (73). Table 1 presents the number of same-sex couples and male same-sex couples in states that offered some level of recognition of same-sex partnerships as of January 2012.

Table 1. States Offering Some Recognition of Same-Sex Partnerships and Number of Same-Sex Couples, January 2012 (55, 62)

	State	Same-sex couples, 2005	Male same-sex couples, 2005
1	California	107,772	59,963
2	Colorado	15,915	7,302
3	Connecticut	10,174	5,274
4	Delaware	2,087	917
5	District of Columbia	3,420	2,319
6	Hawaii	3,262	1,575
7	Illinois	30,013	16,365
8	Iowa	5,833	3,169
9	Maine	4,847	2,062
10	Maryland	15,607	7,992
11	Massachusetts	23,744	11,356
12	Nevada	6,017	2,724
13	New Hampshire	5,578	1,953
14	New Jersey	20,677	12,125
15	New York	50,854	27,267
16	Oregon	10,899	5,339
17	Rhode Island	2,376	1,014
18	Vermont	2,157	1,124
19	Washington	23,903	11,762
20	Wisconsin	14,894	6,909

Herek delineates three arguments in favor of same-sex partnership recognition in more states (58). First, intimate same-sex relationships are not fundamentally different in psychological terms from different-sex relationships (58). Next, same-sex couples, both male and female, are currently raising children just as heterosexual couples do (58). Finally, "marriage confers a variety of tangible and intangible benefits that have important effects on psychological and physical health (58)." In states and municipalities where same-sex couples cannot marry, they are denied these benefits (58).

It is hypothesized that the availability of legally recognized same-sex partnerships will reduce the HIV and STD risk among MSM by encouraging monogamy (60, 70). The assumption is that legally recognized partnerships offer certain important "economic and emotional benefits and that individuals will seek to secure these benefits by reducing their infidelities (70)." Similar arguments have been made for heterosexual couples (71). Same-sex partnerships laws could reduce the stigma associated with homosexuality and consequently decrease the motivation for MSM to engage in clandestine, high-risk sex acts (70, 74). Alternatively, laws recognizing same-sex partnerships might promote the transmission of HIV and STDs if greater expectations of fidelity decrease the willingness of individuals to signal mistrust to a partner by using a condom or some other risk reduction strategy (70, 75). Finally, same-sex partnership laws might not substantially increase sexual exclusivity within couples, but they might change norms so that safe-sex practices are more likely to be followed with casual partners (70).

A few prior studies have examined the hypothesized link between legally recognized marriage and partnerships with risky sexual behavior (60, 70, 71). Stein and colleagues (71) analyzed the association between marriage and risk behaviors among heterosexual couples. This study assessed risk behaviors among 1,061 homeless and/or impoverished people in Los Angeles (71). This sample included 368 couples in intimate heterosexual relationships, of whom 24% were married to each other (71). Over 80% of study participants were black or Hispanic and the age range was 16 to 65 years (71). Based on a multilevel analysis, the authors concluded that marriage had a generally protective effect (71). However, while married couples did report fewer sex partners than intimate couples who were not married, marriage was associated with greater needle sharing among those couples who inject recreational drugs (71).

Klausner and his fellow authors (60) explored the effect of same-sex male domestic partnerships on risk behaviors, especially the number of sex partners. Using data from the Urban Men's Health Study, a representative sample of adult MSM living in MSM-majority zip codes in Chicago, Los Angeles, New York, and San Francisco, this study classified participants into three categories: (1) having a male domestic partner (35.4%), (2) having a male primary partner who is not a domestic partner (13%), and (3) having no steady partner (51.6%) (60). While there was not a statistically significant difference in HIV prevalence among the three groups, three HIV risk behaviors – two or more male sex partners, "one-night stands," and unprotected anal intercourse with a male non-primary partner – were significantly lower among those men who reported having a domestic partner (60). However, there were no statistically significant differences in HIV prevalence and lifetime STD infection among the three groups.

Nevertheless, the effect of domestic partnerships was consistent across the lifespan (60). Multiple sexual partnerships and one-night stands were both lower among those men with a male domestic partner than among those with a male primary, non-domestic partner and among those with no steady partner across the four age groups in the study – 18-29 years of age, 30-39 years, 40-49 years, and 50 years and older (60). For example, among men

18-29 years of age, the percentage reporting two or more male sex partners in the past year was 53.2% for those with a domestic partner, 82.9% for those with a primary, non-domestic partner, and 76.1% for those without a steady partner (60). For men 40-49 years old, 32.2% of men with a domestic partner, 59.7% with a primary, non-domestic partner, and 60.2% with no steady partner reported having had a one-night stand in the previous year (60). Of substantial interest is the finding that the overall and age group effects are “specific to having a domestic partner, not just a primary partner, suggesting that societal and legal recognition have an impact on the maintenance of safer sex behaviors (60).”

Dee (70) explored the link between same-sex partnership laws and the rates of HIV, gonorrhea, and syphilis in nine Western European countries that introduced a “marriage-like” status between 1989 and 2003 – Belgium, Denmark, Finland, France, Germany, Iceland, the Netherlands, Norway, and Sweden. While the definition of a same-sex partnership differs across the nine countries, each does confer non-trivial legal rights, economic benefits, and nationwide recognition to those same-sex couples who have had their commitment formally recognized (70). His model shows that, after the implementation of same-sex partnership laws, STD rates dropped in countries that adopted such laws relative to countries that did not (70). However, it is worth noting that in countries in which these laws were adopted, trends toward lower STD rates, especially HIV and gonorrhea, had begun prior to formal implementation of the laws.

Once controls for linear, country-specific trends were introduced, estimated effects of same-sex partnership laws on both HIV and gonorrhea rates decreased and were not statistically significant (70). However, the introduction of similar controls did not decrease the association between same-sex partnership laws and syphilis rates (70). In fact, in the model including such controls, same-sex partnership laws reduced the incidence of syphilis by 43% (70). Implied long-run estimates suggest that the codification of same-sex partnerships may reduce rates of syphilis infection by 64% (70).

One study has shown that bans against same-sex marriage are positively, although not always statistically significantly, associated with the HIV rate in particular areas (56). This same research, however, did not explore the association between the occurrence of HIV and state or local statutes that allow same-sex marriages or civil unions. Another study examined the unequal access to health insurance among same-sex couples in California (62). The authors note that, due to the strong link between the legal institution of marriage and access to employer-sponsored health insurance, “nonmarried dependents of employed gay men and lesbians may end up bearing more of the costs of their health care than if they were married or otherwise eligible for full dependent coverage (62).” As such, these dependents are less likely to seek medical care and are therefore less likely to be tested and treated for any number of conditions, including HIV.

Perceived Discrimination against MSM

One study estimates that 3.9% of the US population in 2005 was gay, lesbian, or bisexual (55). While 8.1% of the population of the District of Columbia is estimated to be gay, lesbian, or bisexual, New Hampshire (6.5%) is the state with the largest proportion of its population that is gay, lesbian, or bisexual (55). South Dakota (1.9%) is the state with the lowest proportion of its population that is gay, lesbian, or bisexual (55).

Regardless of the state in which they live or the size of the gay community of which they are a part, gay and bisexual men are likely to face discrimination from the mainstream heterosexual community. In 2008, 72.3% of African American and 51.6% of white respondents to the General Social Survey indicated that homosexuality is “always wrong (76)”. According to Blackwell and colleagues, the “exact etiologic source for discrimination against gays and lesbians is multifaceted (57, 77).” This lack of tolerance of sexual minorities by the majority heterosexual population is experienced by gays, lesbians, and bisexuals in myriad ways. Sexual stigma can be defined as the “negative regard, inferior status, and relative powerlessness that society collectively accords to any nonheterosexual behavior, identity, relationship, or community (58).” As with other forms of stigma, sexual stigma is manifested at the societal and individual levels (58). Heterosexism legitimizes the inferior status of sexual minorities relative to heterosexuals in that it promotes a heterosexual assumption and problematizes those people with a nonheterosexual orientation who do become visible (58).

Herek has suggested three manifestations of sexual stigma experienced by sexual minorities – enacted stigma, felt stigma, and internalized stigma (58). Enacted sexual stigma refers to overt expressions of stigma through acts such as antigay epithets, ostracism, and violence (58). In a 2005 national survey of self-identified gays, lesbians, and bisexuals, 21% of respondents had experienced violence or crime against their property (58). This percentage was higher for gay men (38%) relative to lesbians and bisexual men and women (11-13%) (58). Gay men were also more likely to experience other forms of harassment such as verbal abuse and threats of violence (58). In another study, 94% of lesbian, gay, and bisexual adults had experienced at least one hate crime based on their sexual orientation (59, 78).

Herek describes the essence of felt sexual stigma as “the knowledge that enacted stigma can occur under certain circumstances,” leading people to alter their behavior to avoid experiencing harassment, violence, or another type of enacted stigma (58). Felt stigma can lead to high levels of stigma consciousness or stereotype threat and might motivate sexual minorities to utilize stigma management strategies, including trying to pass as heterosexuals (58, 79, 80).

One manifestation of felt stigma is subtle heterosexism. Prior research (59) indicates that subtle heterosexism is related to several facets of the everyday life experience of gay men. While neither gay men nor lesbians nor bisexual individuals indicated that hearing subtly heterosexist remarks would affect the likelihood of their being open about their sexual orientation, gay men were even less likely to be affected than lesbians and bisexuals (59). Nevertheless, hearing such remarks does affect perceptions of prejudice against gay men. While each of the three groups somewhat agreed that they would assume a heterosexual who made subtly heterosexist remarks was prejudiced against gay men, lesbians were significantly more likely to make such an assumption than gay men (59).

Internalized stigma can be defined as “an individual’s personal acceptance of sexual stigma as a part of her or his own value system and self-concept (58).” As with felt stigma, internalized stigma is experienced by heterosexuals as well as sexual minorities (58). This form of sexual stigma is also referred to as internalized homophobia (58, 81), internalized heterosexism (58, 82), and internalized homonegativity (58, 83).

Tied up with the stigma associated with sexual orientation, especially among MSM, is the stigma associated with HIV and AIDS (67). This stigma has both personal and social components. It is personal in that in represents a threat to the mental health and well-being of MSM (67). It is social in that it reflects a “threat to core social values concerning sexual behavior, morality, and religious views (67).” The internalization of these core social values by gays, lesbian, and bisexuals can be referred to as “internalized homophobia.” As opposed to members of other marginalized groups, specifically racial and ethnic minorities, gay and lesbian children do not usually grow up with parents who share their stigmatized identity (61, 84). As such, these children have “neither appropriate gay or lesbian role models nor parental buffers against the antagonistic culture (61)." Well prior to developing awareness of their own sexuality, gay and lesbian children learn the myths and stereotypes related to homosexuality in popular society (61, 85). Learned negative attitudes toward homosexuality are then formally incorporated into a person's self-concept (61).

Internalized homophobia may also be fostered by two ways in which sexual minority stigma is different from the stigma directed at racial, ethnic, or religious minorities. First, a person's sexual orientation is not generally readily apparent to casual observers, allowing sexual minorities to regulate the degree to which other people are aware of their orientation (58). Second, "sexual prejudice is *not* generally regarded as undesirable or inappropriate throughout US society (58)." These phenomena reinforce the legitimacy of sexual stigma and thus increase the likelihood of internalized homophobia.

Previous studies have linked internalized homophobia with sexual risk behavior in MSM (61, 86-89). While three of these studies found a positive association between internalized homophobia and sexual risk taking (86-88), a fourth (89) reported a negative association between internalized homophobia and feelings of self-efficacy for safe sex and a positive association between internalized homophobia and perceptions of interpersonal barriers to safe sex.

Francis and Mialon (56) found that tolerance of MSM was negatively and significantly associated with the HIV rate. More specifically, tolerance was negatively and mostly significantly associated with male-to-male transmission of HIV (56). In other words, as tolerance increases, the transmission of HIV among MSM decreases. To test these findings, the authors tested the association of tolerance with an outcome to which it should have no clear association – the HIV rate among hemophiliacs (56). The hemophiliac HIV rate was found not to be associated with tolerance of MSM (56). Also, as expected, the magnitude of the association between tolerance of MSM and the rate of heterosexually transmitted HIV was substantially less than the magnitude of the association between tolerance and the rate of HIV transmitted via male-to-male sexual contact (56).

Francis and Mialon (56) have theorized that the degree of tolerance of MSM is related to these men's sex behaviors as well as the pool of potential sexual partners. For instance, the less accepting of MSM that a community is, the more likely that MSM in that community are to be driven "underground" and engage in high risk sex (56). Alternatively, a more accepting environment may encourage previously inexperienced MSM to enter the pool of potential sex partners (56). Given their relative inexperience, these MSM are less likely to be HIV-positive and their entry into the pool of sexual partners will thus reduce the overall percentage of HIV-positive MSM (56). One unexplored phenomenon that might have the opposite impact on the prevalence of HIV in a particular state is that tolerance may motivate gay men to move into that state. Since

HIV is positively correlated with the size of a state's gay population, such in-migration might increase HIV prevalence (56).

Social oppression on the basis of sexuality is also heightened by discrimination on the basis of race and/or ethnicity (65) or rural location (67). Diaz and colleagues explored the association of community intolerance of MSM with sexual risk behavior among Latino gay men in Los Angeles, New York, and Miami (65). This study measured experiences of homophobia on an 11-item scale, psychological distress on a four-point scale, participation in difficult sexual situations on a ten-item scale, and sexual risk based on an extensive set of behavioral and interpersonal questions (65). The authors found a clear link between experienced homophobia, racism, and poverty and sexual risk behavior. For instance, the scores on the full homophobia scale as well as on individual items such as "verbal assault in childhood," "family embarrassed and hurt," and "police harassment" were all statistically significantly greater among those in the high sexual risk group than those in the low sexual risk group (65).

Preston and her fellow authors examined the association between stigma and sexual risk in 414 MSM living in rural Pennsylvania (67). The investigators assessed sexual risk, mental health status, and stigma as manifested by the men's perceptions of the attitudes toward homosexuality, HIV, and AIDS held by their family members, health care providers, and the rural communities as a whole (67). Community stigma was found to be significantly higher than family or health care provider stigma (67). Importantly, those men deemed to be high sexual sensation seekers were more likely to perceive their communities as less tolerant of MSM than those men deemed to be low sexual sensation seekers (67). On the other hand, internalized homophobia and other mental health variables were not found to be associated with sexual risk behavior (67).

Internalized homophobia is a main link in the connection between structural and social discrimination and a man's level of outness. Heterosexuals who personally know gay men or lesbians are significantly more favorably inclined toward sexual minorities than those heterosexuals without such personal knowledge (58, 90, 91). In a related fashion, coming out has been shown to be an effective way of decreasing antigay sentiment (59, 92-94). Nevertheless, empirical research has demonstrated that internalized homophobia is negatively associated with a man's level of outness (61). Additionally, a negative relationship has been shown to exist between outness and age as well as education and income (61). On the other hand, outness is positively associated with the number of HIV prevention services of which a man had heard as well as whether or not a man had partaken of such services (61).

While a man's level of outness has been shown to be positively associated with the use of prevention services, it may be negatively associated with participation in risky sex. While one study found that HIV prevalence was significantly higher among disclosers (11%) than non-disclosers (8%) (95), others have found the level of outness to be negatively associated with sexual risk taking among MSM (67) and positively associated with self-efficacy related to the use of condoms and the ability to communicate with sexual partners about their use (61). That is, the more out a man, the less likely he is to engage in risky sexual activities.

Marginalization, Psychological Distress, Sense of Hopelessness, and Sexual Risk

"Sexual risk is influence by individual, interpersonal, and community contexts (96)." An imbalanced community sex ratio and living in segregated conditions as well as the inability of same-sex couples to enter into state-sanctioned marriages and perceptions of discrimination against gay and bisexual men are all likely, to some degree, to generate stress or psychological distress and a corresponding sense of hopelessness. This psychological distress links social marginalization with sexual risk behavior, and, thus, HIV prevalence.

Mark Hatzenbuehler has developed a psychological mediation framework that links sexual minority stigma and stress (66). This framework can be adapted to other marginalized groups that experience psychological distress or hopelessness as a result of their stigmatization. Stigmatized or marginalized populations are subject to stigma-related stressors, which are in turn mediated through three processes – coping/emotion regulation, social/interpersonal, and cognitive – and result in psychopathology (66). While not explicitly contained in this framework, sexual risk behavior could be included as an expression of psychopathology.

Negative treatment from society as a whole has been shown to reduce self-acceptance and lead to abnormally high chronic stress (42, 59, 66, 97, 98). This stress has been linked to participation in high-risk sexual behaviors (42, 59, 99, 100). Other studies have demonstrated a relationship between sexual risk behavior and sex to reduce stress (67, 100, 101). In addition, prior research has shown that social exclusion, or marginalization (66, 102), and stigma (66, 103) are ego-depleting in that "exerting self-control on one task drains the capacity for self-control and impairs performance on subsequent tasks requiring this same resource (66, 103)." In such a way, members of marginalized populations who may be more prone to find themselves in difficult sexual situations (65) are then less able to exert self-control and avoid participating in risky sexual activities.

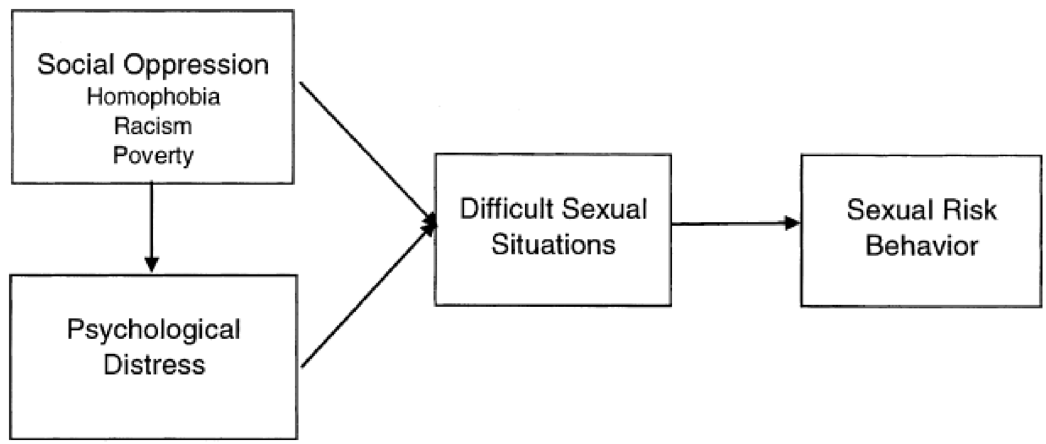
Zierler and Krieger outlined a potential link among racism, stress, and sexual risk-taking when they wrote, "Seeking sanctuary from racial hatred through sexual connection as a way to enhance self-esteem, gain social status, and feel emotional comfort may offer rewards so compelling that condom use becomes less of a priority (26, 104)." More imbalanced community sex ratios are directly linked to racism in the US.

Sobo examines the psychosocial benefits of unsafe sex among inner-city women (105). Some women in socioeconomically disadvantaged contexts might feel compelled to participate in "survival sex" (105, 106) in order to gain certain tangible benefits or avoid certain tangible risks (105). On the other hand, the circumstances which may compel women to engage in survival sex can also lead to depression and hopelessness, which have both been associated with lowered insistence on safe sex practices (105).

Women in areas with a higher prevalence of HIV may also be more inclined to hopelessness, which has been linked to decreased interest in risk reduction (105). In such areas, "safer sex may seem hardly worth the effort (105)." Finally, the psychological distress resulting from sexual relationships between partners with differential power within the relationship can influence sexual risk. For instance, a woman may label as "mutual" a decision not to use condoms with a certain partner in to avoid or decrease feelings of powerlessness and obscure emotional social dependence on men (105).

Diaz and colleagues (65) make the link between social oppression in the form of homophobia, racism, and/or poverty, psychological distress, difficult sexual situations, and sexual risk behavior (Figure 3). The authors showed that a full psychological distress scale as well as five specific manifestations of psychological distress ((1) feeling sick, not well; (2) sleep problems; (3) anxiety (fear or panic for no apparent reason); (4) sad or depressed mood; and (5) suicidal ideation) were all statistically significantly higher among those in the high sexual risk group than among those in the low sexual risk group (65). In addition, a full difficult sexual situation scale as well as ten specific difficult sexual situations ((1) partner refuses condom; (2) sex to relieve depression and loneliness; (3) sex under the influence of alcohol; (4) sex under the influence of drugs; (5) condoms spoil romantic moment; (6) fear of discovery in public place; (7) peer pressure in group sex; (8) sex in someone else's home; (9) erection difficulties; (10) fun in public sex environment) were statistically significantly more common among those in the high sexual risk group than those in the low sexual risk group (65).

Figure 3. Hypothesized Model Linking Social Oppression and HIV Sexual Risk Behavior (65)



Further multivariate analysis showed that social discrimination is a strong predictor of psychological distress (65). In turn, psychological distress combined with experienced homophobia and racism but not poverty statistically significantly predicts participation in difficult sexual situations (65). Other studies of discrimination or hate crimes based on sexual minority status have found elevated levels of psychological distress (58, 107-109) while at least one other study has linked stress and/or psychological distress with sexual risk behaviors (110). Although these studies were conducted in the context of MSM risk behaviors, many, if not most, of the manifestations of psychological distress and descriptions of difficult sexual situations are applicable to more than one marginalized group, including black women living in segregated areas with or without an imbalanced community sex ratio.

RESEARCH QUESTIONS

Disparities in the prevalence of HIV exist. To date, most research into these disparities has focused on individual level factors. While there has been an increased theoretical focus on the impact of certain community level factors on disparities in HIV prevalence, there remain some difficulties in identifying and measuring relevant community level variables for inclusion in epidemiologic analysis. Essential to a multilevel analysis of the association between different manifestations of social marginalization and the prevalence of HIV is the recognition that several factors, including those at the individual, societal, and structural levels, play a role in creating and shaping disparities in HIV infection. Also implied, but less absolute, is the acknowledgment that individual risk behaviors are more closely linked to structural inequalities than to individual choices (32) and that the same behavior carries different risk depending on where an individual falls in the social structure. As such, analyses to determine which of several factors on multiple levels are most closely associated with the prevalence of HIV on a broad geographic basis will likely be more useful in determining the most efficient "leverage points" for the allocation of prevention resources than analyses that are more narrowly focused on a single individual level variable while controlling for potential confounders.

The need to address factors at multiple levels is recognized to such an extent that, in its *National HIV/AIDS Strategy*, the White House Office of National AIDS Policy included community level indicators in addition to the standard aggregated individual level measures (111). The best way to prevent new HIV infections and reduce community viral load is likely to address simultaneously factors at the individual, societal, and structural levels. Societal and structural factors may be more amenable to efficient and effective intervention because results are likely more tangible and more concretely measureable than are the results of interventions aimed at certain individual level characteristics, such as risk behaviors, which may be less remediable via large-scale prevention efforts. However, based on current evidence, the association between HIV prevalence and community level factors is less clear than the link between HIV infection and certain widely recognized individual level risk factors.

Given the likely amenability of societal and structural factors to intervention and amelioration, the current lack of concrete evidence regarding the association of such factors with HIV prevalence on a national level, and the strong link between HIV infection and certain individual level elements, future analyses aimed at framing the allocation of finite prevention resources must account for factors associated with HIV infection at multiple levels. In light of this, my proposed dissertation research questions are:

1. Is the community sex ratio associated with prevalent HIV infection among black women?
2. Is perceived discrimination against gay and bisexual men associated with prevalent HIV infection among these men?

3. Is structural discrimination against MSM associated with HIV status among these men?

REFERENCES

1. Mays VM, Cochran SD. Acquired Immunodeficiency Syndrome and black Americans: special psychosocial issues. Public Health Rep. 1987;102(2):224-231.
2. Centers for Disease Control and Prevention. HIV Surveillance Report, 2008. http://www.cdc.gov/hiv/topics/surveillance/resources/reports/. Accessed March 31, 2012.
3. Prejean J, Song R, Hernandez A, Ziebell R, Green T, Walker F, et al. Estimated HIV incidence in the United States, 2006-2009. PLoS One. 2011;6(8):e17502.
4. Centers for Disease Control and Prevention. Characteristics associated with HIV infection among heterosexuals in urban areas with high AIDS prevalence - 24 cities, United States, 2006-2007. MMWR. 2011;60(31):1045-9.
5. Hall HI, Song R, Rhodes P, Prejean J, An Q, Lee LM, et al. Estimation of HIV incidence in the United States. JAMA. 2008;300(5):520-9.
6. Sullivan PS, Hamouda O, Delpech V, Geduld JE, Prejean J, Semaille C, et al. Reemergence of the HIV epidemic among men who have sex with men in North America, Western Europe, and Australia, 1996-2005. Ann Epidemiol. 2009;19(6):423-31.
7. Lyles CM, Kay LS, Crepaz N, Herbst JH, Passin WF, Kim AS, et al. Best-evidence interventions: findings from a systematic review of HIV behavioral interventions for US populations at high risk, 2000-2004. Am J Public Health. 2007;97(1):133-43.

8. Hodder SL, Justman J, Haley DF, Adimora AA, Fogel CI, Golin CE, et al. Challenges of a hidden epidemic: HIV prevention among women in the United States. J Acquir Immune Defic Syndr. 2010;55 Suppl 2:S69-73.

9. Tarlov AR. Public policy frameworks for improving population health. Ann N Y Acad Sci. 1999;896:281-93.

10. Ansari Z, Carson NJ, Ackland MJ, Vaughan L, Serraglio A. A public health model of the social determinants of health. Soz Praventivmed. 2003;48(4):242-51.

11. Stronks K, van de Mheen HD, Mackenbach JP. A higher prevalence of health problems in low income groups: does it reflect relative deprivation? J Epidemiol Community Health. 1998;52(9):548-57.

12. Marmot MG, Wilkinson RG. Social determinants of health. Oxford; New York: Oxford University Press; 1999.

13. Lynch JW, Smith GD, Kaplan GA, House JS. Income inequality and mortality: importance to health of individual income, psychosocial environment, or material conditions. BMJ. 2000;320(7243):1200-4.

14. El-Sadr WM, Mayer KH, Hodder SL. AIDS in America--forgotten but not gone. N Engl J Med. 2010;362(11):967-70.

15. Poundstone KE, Strathdee SA, Celentano DD. The social epidemiology of human immunodeficiency virus/acquired immunodeficiency syndrome. Epidemiol Rev. 2004;26:22-35.

16. Vasas EB. Examining the margins - A concept analysis of marginalization. ANS Adv Nurs Sci. 2005;28(3):194-202.

17. Reidpath DD, Chan KY, Gifford SM, Allotey P. 'He hath the French pox': stigma, social value and social exclusion. Sociol Health Ill. 2005;27(4):468-489.

18. Link BG, Phelan JC. Conceptualizing stigma. Annu Rev Sociol. 2001;21:363-385.

19. Crocker J, Major B, Steele C. Social stigma. In: Gilbert DT, Fiske ST, editors. The Handbook of Social Psychology. Boston: McGraw-Hill; 1998. p. 504-53.

20. Hallfors DD, Iritani BJ, Miller WC, Bauer DJ. Sexual and drug behavior patterns and HIV and STD racial disparities: the need for new directions. Am J Public Health. 2007;97(1):125-32.

21. Lane SD, Rubinstein RA, Keefe RH, Webster N, Cibula DA, Rosenthal A, et al. Structural violence and racial disparity in HIV transmission. J Health Care Poor Underserved. 2004;15(3):319-335.

22. Wyatt GE, Myers HF, Williams JK, Kitchen CR, Loeb T, Carmona JV, et al. Does a history of trauma contribute to HIV risk for women of color? Implications for prevention and policy. Am J Public Health. 2002;92(4):660-5.

23. Tillerson K. Explaining racial disparities in HIV/AIDS incidence among women in the U.S.: a systematic review. Stat Med. 2008;27(20):4132-43.

24. Leichliter JS, Aral SO. Black women in the United States decrease their number of recent sex partners: temporal trends from the national survey of family growth. Sex Transm Dis. 2009;36(1):1-3.

25. Leichliter JS, Chesson HW, Sternberg M, Aral SO. The concentration of sexual behaviours in the USA: a closer examination of subpopulations. Sex Transm Infect. 2010;86 Suppl 3:45-51.

26. Zierler S, Krieger N. Reframing women's risk: Social inequalities and HIV infection. Annu Rev Public Health. 1997;18:401-436.

27. Adimora AA, Schoenbach VJ. Social context, sexual networks, and racial disparities in rates of sexually transmitted infections. J Infect Dis. 2005;191 Suppl 1:S115-22.

28. Adimora AA, Schoenbach VJ, Doherty IA. HIV and African Americans in the southern United States: sexual networks and social context. Sex Transm Dis. 2006;33(7 Suppl):S39-45.

29. Adimora AA, Schoenbach VJ, Floris-Moore MA. Ending the epidemic of heterosexual HIV transmission among African Americans. Am J Prev Med. 2009;37(5):468-71.

30. Aral SO, Adimora AA, Fenton KA. Understanding and responding to disparities in HIV and other sexually transmitted infections in African Americans. Lancet. 2008;372(9635):337-40.

31. Harawa N, Adimora A. Incarceration, African Americans and HIV: advancing a research agenda. J Natl Med Assoc. 2008;100(1):57-62.

32. Lemelle AJ, Jr. Racialized social system and HIV infection: the case of African Americans. International Journal of Sociology and Social Policy. 2002;22(4-6):133-158.

33. Pouget ER, Kershaw TS, Niccolai LM, Ickovics JR, Blankenship KM. Associations of sex ratios and male incarceration rates with multiple opposite-sex partners: potential social determinants of HIV/STI transmission. Public Health Rep. 2010;125 Suppl 4:70-80.

34. Sanders-Phillips K. Factors influencing HIV/AIDS in women of color. Public Health Rep. 2002;117(3):S151-S156.

35. Cargill VA, Stone VE. HIV/AIDS: a minority health issue. Med Clin North Am. 2005;89(4):895-912.

36. Doherty IA, Leone PA, Aral SO. Social determinants of HIV infection in the Deep South. Am J Public Health. 2007;97(3):391.

37. Cooper HL, Friedman SR, Tempalski B, Friedman R. Residential segregation and injection drug use prevalence among Black adults in US metropolitan areas. Am J Public Health. 2007;97(2):344-52.

38. Thomas JC, Levandowski BA, Isler MR, Torrone E, Wilson G. Incarceration and sexually transmitted infections: A neighborhood perspective. J Urban Health. 2008;85(1):90-99.

39. Friedman SR, Cooper HLF, Osborne AH. Structural and social contexts of HIV risk among African Americans. Am J Public Health. 2009;99(6):1002-1008.

40. Adimora AA, Auerbach JD. Structural interventions for HIV prevention in the United States. J Acquir Immune Defic Syndr. 2010;55 Suppl 2:S132-5.

41. Higgins JA, Hoffman S, Dworkin SL. Rethinking gender, heterosexual men, and women's vulnerability to HIV/AIDS. Am J Public Health. 2010;100(3):435-45.

42. Ickovics J, Beren S, Grigorenko E, Morrill A, Druley J, Rodin J. Pathways of risk: race, social class, stress, and coping as factors predicting heterosexual risk behaviors for HIV among women. AIDS Behav. 2002;6:339-50.

43. Williams DR. Race, socioeconomic status, and health. The added effects of racism and discrimination. Ann N Y Acad Sci. 1999;896:173-88.

44. Bonilla-Silva E. Rethinking racism: toward a structural interpretation. Center for Research on Social Organization Working Paper Series. 1994;526:1-64.

45. Doyle R. Fewer men, more crime. Sci Am. 2005;293(5):32.

46. Adimora AA, Schoenbach VJ. Contextual factors and the black-white disparity in heterosexual HIV transmission. Epidemiology. 2002;13(6):707-712.

47. Senn TE, Carey MP, Vanable PA, Urban MA, Sliwinski MJ. The male-to-female ratio and multiple sexual partners: multilevel analysis with patients from an STD clinic. AIDS Behav. 2008;14(4):942-8.

48. Bontempi JM, Eng E, Quinn SC. Our men are grinding out: a qualitative examination of sex ratio imbalances, relationship power, and low-income African American women's health. Women Health. 2008;48(1):63-81.

49. Logan TK, Cole J, Leukefeld C. Women, sex, and HIV: social and contextual factors, meta-analysis of published interventions, and implications for practice and research. Psychol Bull. 2002;128(6):851-85.

50. Gouveia-Oliveira R, Pedersen AG. Higher variability in the number of sexual partners in males can contribute to a higher prevalence of sexually transmitted diseases in females. J Theor Biol. 2009;261(1):100-6.

51. Harris G, Mallory C, Stampley C. A qualitative study of man-sharing and the implications for midlife African American women's risk for HIV infection. Women Health. 2010;50(7):670-87.

52. Thomas JC, Sampson LA. High rates of incarceration as a social force associated with community rates of sexually transmitted infection. J Infect Dis. 2005;191 Suppl 1:S55-60.

53. Thomas JC, Gaffield ME. Social structure, race, and gonorrhea rates in the southeastern United States. Ethn Dis. 2003;13(3):362-8.

54. Kilmarx PH, Zaidi AA, Thomas JC, Nakashima AK, St Louis ME, Flock ML, et al. Sociodemographic factors and the variation in syphilis rates among US counties, 1984 through 1993: an ecological analysis. Am J Public Health. 1997;87(12):1937-43.

55. Gates GJ. Same-sex couples and the gay, lesbian, bisexual population: new estimates from the American Community Survey. Los Angeles, CA: The Williams Institute, UCLA; 2006.

56. Francis AM, Mialon HM. Tolerance and HIV. J Health Econ. 2010;29(2):250-67.

57. Blackwell CW, Ricks JL, Dzielgielewski SF. Discrimination of gays and lesbians: a social justice perspective. J Health Soc Policy. 2004;19(4):27-43.

58. Herek GM. Confronting sexual stigma and prejudice: Theory and practice. J Soc Issues. 2007;63(4):905-925.

59. Burn SM, Kadlec K, Rexer R. Effects of subtle heterosexism on gays, lesbians, bisexuals. J Homosex. 2005;49(2):23-38.

60. Klausner JD, Pollack LM, Wong W, Katz MH. Same-sex domestic partnerships and lower-risk behaviors for STDs, including HIV infection. J Homosex. 2006;51(4):137-44.

61. Huebner DM, Davis MC, Nemeroff CJ, Aiken LS. The impact of internalized homophobia on HIV preventive interventions. Am J Community Psychol. 2002;30(3):327-48.

62. Ponce NA, Cochran SD, Pizer JC, Mays VM. The effects of unequal access to health insurance for same-sex couples in California. Health Aff (Millwood). 2010;29(8):1539-48.

63. Mills TC, Stall R, Pollack L, Paul JP, Binson D, Canchola J, et al. Health-related characteristics of men who have sex with men: a comparison of those living in "gay ghettos" with those living elsewhere. Am J Public Health. 2001;91(6):980-3.

64. Frye V, Latka MH, Koblin B, Halkitis PN, Putnam S, Galea S, et al. The urban environment and sexual risk behavior among men who have sex with men. J Urban Health. 2006;83(2):308-24.

65. Diaz RM, Ayala G, Bein E. Sexual risk as an outcome of social oppression: data from a probability sample of Latino gay men in three U.S. cities. Cultur Divers Ethnic Minor Psychol. 2004;10(3):255-67.

66. Hatzenbuehler ML. How does sexual minority stigma "get under the skin"? A psychological mediation framework. Psychol Bull. 2009;135(5):707-30.

67. Preston DB, D'Augelli AR, Kassab CD, Starks MT. The relationship of stigma to the sexual risk behavior of rural men who have sex with men. AIDS Educ Prev. 2007;19(3):218-30.

68. Goldberg AE, Smith JZ. Stigma, social context, and mental health: lesbian and gay couples across the transition to adoptive parenthood. J Couns Psychol. 2011;58(1):139-50.

69. Rostosky SS, Riggle ED, Horne SG, Denton FN, Huellemeier JD. Lesbian, gay, and bisexual individuals' psychological reactions to amendments denying access to civil marriage. Am J Orthopsychiatry. 2010;80(3):302-10.

70. Dee TS. Forsaking all others? The effects of same-sex partnership laws on risky sex. Econ J. 2008;118(530):1055-1078.

71. Stein JA, Nyamathi A, Ullman JB, Bentler PM. Impact of marriage on HIV/AIDS risk behaviors among impoverished, at-risk couples: a multilevel latent variable approach. AIDS Behav. 2007;11(1):87-98.

72. Barbaro M. After long wait, same-sex couples marry in New York. The New York Times. July 24, 2011.

73. Human Rights Campaign. Issue: Marriage. http://www.hrc.org/issues/marriage. Accessed March 31, 2012.

74. Mueller C. An economic analysis of same-sex marriage. German Working Papers in Law and Economics. http://www.bepress.com/gwp/default/vol2002/iss1/art14. Accessed March 31, 2012.

75. Elford J, Bolding G, Maguire M, Sherr L. Sexual risk behaviour among gay men in a relationship. AIDS. 1999;13(11):1407-11.

76. Glick SN, Golden MR. Persistence of racial differences in attitudes toward homosexuality in the United States. J Acquir Immune Defic Syndr. 2010;55(4):516-23.

77. Herek GM. Gender gaps in public opinion about lesbians and gay men. Public Opin Quart. 2002;66(1):40-66.

78. Herek GM, Cogan JC, Gillis JR. Victim experiences in hate crimes based on sexual orientation. J Soc Issues. 2002;58(2):319-339.

79. Pinel EC. Stigma consciousness: the psychological legacy of social stereotypes. J Pers Soc Psychol. 1999;76(1):114-128.

80. Bosson JK, Haymovitz EL, Pinel EC. When saying and doing diverge: The effects of stereotype threat on self-reported versus non-verbal anxiety. J Exp Soc Psychol. 2004;40(2):247-255.

81. Weinberg GH. Society and the healthy homosexual. New York,: St. Martin's Press; 1972.

82. Szymanski DM, Chung YB. Feminist attitudes and coping resources as correlates of lesbian internalized heterosexism. Feminism & Psychology. 2003;13(3):369-389.

83. Mayfield W. The development of an Internalized Homonegativity Inventory for gay men. J Homosex. 2001;41(2):53-76.

84. Fergus S, Lewis MA, Darbes LA, Butterfield RM. HIV risk and protection among gay male couples: The role of gay community integration. Health Educ Behav. 2005;32(2):151-171.

85. Malyon AK. Psychotherapeutic implications of internalized homophobia in gay men. J Homosex. 1982;7(2-3):59-69.

86. Meyer IH, Dean L. Internalized homophobia, intimacy, and sexual behavior among gay and bisexual men. In: Herek GM, editor. Stigma and Sexual Orientation: Understanding Prejudice Against Lesbians, Gay Men and Bisexuals. Thousand Oaks, CA: Sage; 1998.

87. Waldo CR, Kegeles SM, Hays RB. Self-acceptance of gay identity predicts decreased sexual risk behavior and increased psychological health in U.S. young gay men. 12th International AIDS Conference. Geneva, Switzerland. 1998.

88. Stokes JP, Peterson JL. Homophobia, self-esteem, and risk for HIV among African American men who have sex with men. AIDS Educ Prev. 1998;10(3):278-292.

89. Herek GM, Glunt EK. Identity and community among gay and bisexual men in the AIDS era: preliminary findings from the Sacramento Men's Health Study. In: Herek GM, B. G, editors. Psychological Perspectives on Lesbian and Gay Issues: AIDS, Identity, and Community: The HIV Epidemic and Lesbians and Gay Men. Thousand Oaks, CA: Sage; 1995. p. 55-84.

90. Herek GM, Capitanio JP. "Some of my best friends": Intergroup contact, concealable stigma, and heterosexuals' attitudes toward gay men and lesbians. Pers Soc Psychol B. 1996;22(4):412-424.

91. Pettigrew TF, Tropp LR. A meta-analytic test of intergroup contact theory. J Pers Soc Psychol. 2006;90(5):751-783.

92. Herek GM, Glunt EK. Interpersonal contact and heterosexuals attitudes toward gay men - results from a national survey. J Sex Res. 1993;30(3):239-244.

93. D'Augelli AR, Rose ML. Homophobia in a university community: attitudes and experiences of heterosexual freshmen. J College Student Dev. 1990;31:484-491.

94. Herek GM. Beyond "homophobia": a social psychological perspective on attitudes toward lesbians and gay men. J Homosex. 1984;10(1-2):1-21.

95. Centers for Disease Control and Prevention. HIV/STD risks in young men who have sex with men who do not disclose their sexual orientation - six U.S. cities, 1994-2000. MMWR. 2003;52(5):81-86.

96. Fergus S, Lewis MA, Darbes LA, Kral AH. Social support moderates the relationship between gay community integration and sexual risk behavior among gay male couples. Health Educ Behav. 2009;36(5):846-59.

97. Meyer IH. Minority stress and mental health in gay men. J Health Soc Behav. 1995;36(1):38-56.

98. Huebner DM, Rebchook GM, Kegeles SM. Experiences of harassment, discrimination, and physical violence among young gay and bisexual men. Am J Public Health. 2004;94(7):1200-3.

99. Rotheram-Borus MJ, Reid H, Rosario M, Kasen S. Determinants of safer sex patterns among gay/bisexual male adolescents. J Adolesc. 1995;18:3-15.

100. Folkman S, Chesney M, Pollack L, Coates T. Stress, control, coping, and depressive mood in Human Immunodeficiency Virus-positive and Virus-negative gay men in San-Francisco. J Nerv Ment Dis. 1993;181(7):409-416.

101. McKusick L, Hoff CC, Stall R, Coates TJ. Tailoring AIDS prevention: differences in behavioral strategies among heterosexual and gay bar patrons in San Francisco. AIDS Educ Prev. 1991;3(1):1-9.

102. Baumeister RF, DeWall CN, Ciarocco NJ, Twenge JM. Social exclusion impairs self-regulation. J Pers Soc Psychol. 2005;88(4):589-604.

103. Inzlicht M, McKay L, Aronson J. Stigma as ego depletion: how being the target of prejudice affects self-control. Psychol Sci. 2006;17(3):262-9.

104. Ickovics JR, Rodin J. Women and AIDS in the United-States - epidemiology, natural history, and mediating mechanisms. Health Psychol. 1992;11(1):1-16.

105. Sobo EJ. Inner-city women and AIDS: the psycho-social benefits of unsafe sex. Cult Med Psychiatry. 1993;17(4):455-85.

106. Muir M. The environmental context of AIDS. New York: Praeger; 1991.

107. Szymanski DA. Heterosexism and sexism as correlates of psychological distress in lesbians. J Couns Dev. 2005;83(3):355-360.

108. Mills TC, Paul J, Stall R, Pollack L, Canchola J, Chang YJ, et al. Distress and depression in men who have sex with men: the Urban Men's Health Study. Am J Psychiatry. 2004;161(2):278-85.

109. McLaughlin KA, Hatzenbuehler ML, Keyes KM. Responses to discrimination and psychiatric disorders among Black, Hispanic, female, and lesbian, gay, and bisexual individuals. Am J Public Health. 2010;100(8):1477-84.

110. Burchell AN, Calzavara LM, Myers T, Remis RS, Raboud J, Corey P, et al. Stress and increased HIV infection risk among gay and bisexual men. AIDS. 2010;24(11):1757-64.

111. White House Office of National AIDS Policy. National HIV/AIDS Strategy for the United States. http://www.whitehouse.gov/administration/eop/onap/nhas. Accessed March 31, 2012.

CHAPTER 2

Methods

This chapter describes the methods employed to perform the analyses for each of my dissertation research questions. For each research question, all relevant data sources are discussed first. This is followed by an overview of the outcome of interest and how it is specified. Third, the different measures of each community level exposure of interest are reviewed. Next, the potential individual level confounders and modifiers and how they are specified for each analysis are discussed. Finally, the analytic approach for each distinct set of analyses is covered.

COMMUNITY SEX RATIO ANALYSES

This section describes the methods employed to answer the research question:

1. Is the community sex ratio associated with HIV status among black women?

The outcome of interest was HIV status. All individual level variables, including HIV status, were derived from the first heterosexual iteration of the Center for Disease Control and Prevention's (CDC) (National HIV Behavioral Surveillance System (NHBS-HET1). Data on the exposures of interest – community sex ratios – were derived from the American Community Survey (ACS).

Data Source: NHBS-HET1

In 2002, CDC awarded supplemental funds to state and local health departments to develop and implement a surveillance system to monitor behaviors that place people at risk for HIV infection – NHBS. Eligible awardees were those health departments whose jurisdictions included the 25 Metropolitan Statistical Areas (MSAs) and Metropolitan (Metro) Divisions in the United States (US) with the highest AIDS prevalence in 2000 (1). The 24 of these MSAs and Metro Divisions in the continental US (San Juan, PR, excluded) are presented in Figure 1.

Figure 1. MSAs and Metro Divisions Represented in NHBS-HET1 (2)

In each MSA or Metro Division, the major city or epicenter of HIV and AIDS cases was the focus of data collection efforts. While the first two NHBS cycles focused on men who have sex with men (MSM) and injection drug users, respectively, the third cycle focused on heterosexuals at risk for HIV infection. The three cycles are being repeated over time so that data are collected from any given risk group every three years. The data used for the community sex ratio analyses were collected as part of the first iteration of the NHBS-HET cycle.

Because of the need to do more developmental work in terms of a definition for a heterosexual at high risk for HIV infection, several potential definitions were considered (1). For purposes of NHBS-HET1, the definition of a heterosexual at risk for acquiring HIV included those who have a physical or social connection to a geographic area characterized by higher poverty, high rates of HIV/AIDS, and other sexually transmitted infections (STIs) (1). Given this definition, two sampling methods were used – Venue-Based Sampling (VBS) and Respondent-Driven Sampling (RDS) (1).

VBS is a cross-sectional survey of men and women who attend venues within locally defined geographic areas (1). Survey methods can be grouped into three activities. First, literature reviews and interviews were conducted to develop an initial list of venues (i.e., venue universe) (1). Second, sampling frames of venues and venue-specific-day-time periods expected to produce sufficient numbers of eligible respondents were conducted (1). Standardized enumerations of eligible heterosexuals were used to help select which venues and day-time periods were included in sampling frames (1). The survey was conducted at venues and during day-time periods randomly sampled from constructed frames (1).

RDS is a chain referral strategy similar to snowball sampling. It is founded in the premise that peers are better able than researchers to locate and recruit members of a hidden population (1, 3, 4). RDS provides for sample selection and evaluation of the reliability of the data obtained and thus allows for inferences about the characteristics of the population from which the sample is drawn (1, 5). The method uses quotas to reduce bias from oversampling respondents with larger networks. The final sample is stable in its characteristics and is independent of the initial recruiters ("seeds") from which it began (1). Information gathered during sampling provides the means for constructing a sampling frame from which sampling probabilities can be calculated (1). The variability of population estimates can then be determined (1).

All VBS venue attendees were considered to have a physical connection to a high-risk area because every venue was located within a high-risk area (1). For RDS participants, those living in the high-risk area were considered to have a physical connection and those who do not live in a high-risk area but were recruited by persons who live in a high-risk area were considered to have a social connection (1). Regardless of the sampling method used, the target size for each MSA or Metro Divisions was 500 eligible respondents (1). To be considered, respondents were required to be 18 years of age or older; either male or female (not transgender); live in a participating MSA or Metro Division; and have had vaginal or anal sex with a person of the opposite sex in the previous 12 months (1). The original objectives of NHBS-HET1 included assessing the prevalence of, and trends in, sexual and drug use risk behaviors and HIV testing behaviors as well as assessing the exposure to and use of prevention services (1). Participants were also offered an HIV test.

Data Source: American Community Survey

The US Bureau of the Census developed the ACS to provide a more dynamic method of collecting population data between decennial censuses (6). ACS is a continuous nationwide survey of housing units. Approximately three million addresses are surveyed annually using three modes that take place over a three-month period – mail, telephone, and personal visit (6).

The ACS collects detailed demographic, social, economic, and housing data from the 50 states, the District of Columbia (DC), and Puerto Rico that were previously collected from the long form sample of the decennial census (6). Demographic characteristics include sex, age, race, and Hispanic origin while social characteristics include education, marital status, place of birth, and citizenship status (6). Economic and housing data collected include income and employment status, housing tenure and value, mortgage, and monthly rent (6).

Data for the ACS are collected continuously throughout the year and then aggregated over a specific timeframe (6). The data are published based on time and population thresholds. One-year estimates cover geographic areas with a population of 65,000 or more. Three-year estimates are published for areas with estimated populations of 20,000. For areas with an estimated population less than 20,000, five years are required to amass a large enough sample to provide estimates with accuracy similar to the decennial census long form (6).

Community level numbers were calculated using the ACS 2005-09 five-year sample (Tables B01001, B01001A, and B01001B). The racial/ethnic delineation of black, not Hispanic is not available from ACS via American Fact Finder (http://factfinder.census.gov) so the population of interest for the community sex ratio analyses is black (Hispanic and not Hispanic) women. An initial attempt was made to calculate the number of black, not Hispanic, women estimated in the ACS 2005-09 5-year sample by a “back calculation” process, but this proved unwieldy, yielding negative population numbers in certain geographic areas. This should not prove to be an issue since the percentage of black women in the final NHBS-HET1 sample of women reporting their race as black and their ethnicity as Hispanic was relatively small (2.5%). Including black Hispanic respondents is also conservative because HIV prevalence was lower among black Hispanics than among non-black Hispanics. Finally, ACS estimates of multiracial subpopulations and NHBS-HET1 respondents identifying themselves as multiracial were not included.

Outcome of Interest: HIV Status

The outcome variable was HIV infection (yes (=1)/no(=0)). Not all eligible respondents self-reported their HIV status as part of the survey. Others did not assent to HIV testing. In addition, among some of the respondents who did assent to HIV testing, a definitive test result (i.e., positive or negative) was not available. Therefore, HIV status was based on a combination of self-reported status and the results of HIV tests administered during the NHBS-HET1 survey. Preference was given to test results. In other words, if a person reported being HIV-positive but test results showed them to be HIV-negative, then that respondent was considered HIV-negative. Only respondents with a known value for HIV status (positive or negative) were included in the analyses. Those for whom final HIV status was “unknown,” “indeterminate,” or “missing” were excluded.

Concordance between the two ways of measuring HIV status – testing and self-report – was assessed. Among all NHBS-HET1 respondents who self-reported HIV status, 96.9% self-reported negative and tested negative while 1.1% self-reported positive and tested positive. There was discordance between self-reported status and test result among 1.2% of respondents who self-reported HIV status. Looking specifically at black female NHBS-HET1 respondents who self-reported HIV status, of those self-reporting as negative, 98.2% tested negative and 1.2% tested positive. Among black female NHBS-HET1 respondents self-reporting HIV status as positive, 82.8% tested positive and 9.4% tested negative. The percentages do not total 100% since some respondents were classified as “unknown,” “indeterminate,” or “missing.”

Exposure of Interest: Community Sex Ratio

Data for the community sex ratio analyses were derived from the ACS. While the community sex ratio is traditionally calculated as the simple ratio of males to females in the area of interest, my analyses included age- and race-specific means of operationalizing the sex ratio. These relatively novel ratios may be better suited than more traditional measures in terms of the association between an imbalanced male:female ratio and HIV status in women. The ratios considered in the analyses were:

- <u>Overall male:female sex ratio, 0+</u>: calculated using all men and women of all races and ages in all areas of interest.
- <u>Overall male:female sex ratio, 18+</u>: calculated using all men and women of all races, ages 18 years and older in all areas of interest.
- <u>Overall male:female sex ratio, 18-44</u>: calculated using all men and women of all races, ages 18 to 44 years in all areas of interest.
- <u>Black matched sex ratio, 0+</u>: calculated using black men and women of all ages in all areas of interest.
- <u>Black matched sex ratio, 18+</u>: calculated using black men and women ages 18 years and older in all areas of interest.
- <u>Black matched sex ratio, 18-44</u>: calculated using black men and women ages 18 to 44 years in all areas of interest. This may be the most applicable because NHBS-HET1 respondents were limited to be between ages 18 and 50.

County as "Level 2" for Community Sex Ratio Analyses

Since the majority of black female NHBS-HET1 respondents resided in the core urban areas of the sampled MSAs or Metro Divisions, analyses were limited to those counties with 10% or greater of the relevant MSA or Metro Division's black female NHBS-HET1 respondents or those that were geographically continuous to more than one county with 10% of more of black female NHBS-HET1 respondents (i.e., Queens County (NY) included even though it did not represent 10% of New York City Metropolitan Division's black female NHBS-HET1 respondents because Bronx County (NY), Kings County (NY), and New York County (NY) were included). For the Boston New England City & Town Area (NECTA), NHBS-HET1 survey sampling was based on towns rather than counties. This was taken into consideration when calculating the overall ratios for the relevant Boston communities. Three towns from the Boston NECTA (Dorchester, Lawrence, and Roxbury) were included because they represented greater than 10% of black female NHBS-HET1 respondents for the Boston NECTA. For analytic purposes, these towns were considered equivalent to counties. The full list of counties considered is presented in Table 1.

Table 1. Counties Considered for Community Sex Ratio Analyses

	MSA/ Metro Division	State*	County	Black Female NHBS-HET1 Respondents in County
1	Atlanta	GA	DeKalb	42
2	Atlanta	GA	Fulton	295
3	Baltimore	MD	Baltimore City	135
4	Boston	MA	Dorchester	29
5	Boston	MA	Lawrence	8
6	Boston	MA	Roxbury	23
7	Chicago	IL	Cook	330
8	Dallas	TX	Dallas	608
9	Denver	CO	Denver	225
10	Detroit	MI	Wayne	460
11	Fort Lauderdale	FL	Broward	179
12	Houston	TX	Harris	572
13	Las Vegas	NV	Clark	165
14	Los Angeles	CA	Los Angeles	455
15	Miami	FL	Miami-Dade	251
16	Nassau-Suffolk	NY	Nassau	245
17	Nassau-Suffolk	NY	Suffolk	95
18	Newark	NJ	Essex	315
19	New Haven	CT	Fairfield	99
20	New Haven	CT	New Haven	158
21	New Orleans	LA	Orleans Parish	427
22	New York	NY	Bronx	57
23	New York	NY	Kings	163
24	New York	NY	New York	114
25	New York	NY	Queens	4
26	Philadelphia	PA	Philadelphia	220
27	San Diego	CA	San Diego	79
28	San Francisco	CA	San Francisco	238
29	Seattle	WA	King	151
30	St. Louis	MO	St. Louis	406
31	St. Louis	MO	St. Louis City	76
32	Washington, DC	DC	District of Columbia	465

*Since some MSAs or Metro Divisions span more than one state, this refers to the "predominant" state for each MSA or Metro Division.

The counties listed in Table 1 represent a total sample size of 7,089. However, DeKalb County (GA), Las Vegas County (NV), and St. Louis County (MO) were eventually dropped because of zero prevalence of HIV, leaving a total sample size of 6,806 for the community sex ratio analyses. It is believed that zero prevalence in these counties was due to sampling issues rather than there being no prevalent cases of HIV in these areas.

Each of the ratios described above was calculated for each census tract in the counties of interest that contained at least one female black NHBS-HET1 respondent, after which a single weighted mean (based on the number of respondents in each tract) was calculated for each county of interest. This was done so that the individual level outcome and potential modifiers and confounders were matched as closely as possible to the Level 2 unit of analysis – the county. All community sex ratios were included in the model analyses at the county level as continuous. For the purposes of descriptive statistics, the ratios were operationalized as ordinal variables (ranging from highly imbalanced in favor of women (i.e., substantially more women than men) to relatively balanced to highly imbalanced in favor of men (i.e., substantially more men than women).

Potential Individual Level Effect Modifiers and Confounders

Data on all individual level factors were derived from NHBS-HET1. While some of the individual level variables remaining after the correlation and collinearity assessments were examined as potential effect modifiers, all were included as potential confounders.

To the extent possible, individual level variables were coded such that the highest numbers were associated with the theorized probability of positive HIV status. The individual level variables considered are described below.

Age

Age was considered as an ordinal variable:

- 45 to 50 (=5).
- 40 to 44 (=4).
- 35 to 39 (=3).
- 30 to 34 (=2).
- 25 to 29 (=1).
- 18 to 24 (=0).

Income

Annual household income was stratified into the following groups based, to the extent possible, on the distribution in the sample population:

- $0 to $4,999 (=3).
- $5,000 to $9,999 (=2).
- $10,000 to $29,999 (=1).
- $30,000 or more (=0).

Education

Educational attainment was categorized as:

- None to grade 11 (=2).
- Grade 12 or GED (=1).
- Some college, associate's or bachelor's degree, any post graduate studies (=0).

Employment Status

Based on the relevant NHBS-HET1 question, employment status was categorized as:

- Disabled for work (=3).
- Unemployed (=2).
- Retired or other (=1).
- Employed full-time, employed part-time, homemaker, or full-time student (=0).

Housing Status

Housing status was categorized as:

- Currently homeless (=2).
- Homeless at some point in prior 12 months but currently housed (=1).
- Not homeless at any point in prior 12 months (=0).

Marital Status

Marital status was initially considered as a categorical and using dummy variables. However, it was decided that this variable may potentially lie in the hypothesized causal pathway. Therefore, it was removed from consideration in the analyses.

Partner Incarceration History

NHBS-HET1 female respondents were asked whether or not their last male sex partner had ever been in jail or prison for greater than 24 hours. Since the likelihood that their last partner has spent time in jail or prison is related to both the sex ratio and HIV status, this variable was included in the analyses. It was operationalized dichotomously (yes/no).

Other Sexually Transmitted Infections

Other STIs such as syphilis, gonorrhea, or chlamydia are often found in persons with HIV. These were initially considered for inclusion in the model analyses, but it was decided that they were in the hypothesized causal pathway between the exposures and the outcome of interest and were thus not controlled for in the model analyses.

Number and Type of Sex Partners

Respondents were asked how many main, casual, and exchange sex partners they have. A main partner was defined as a “man you have sex with and who you feel committed to above anyone else.” While a casual partner was defined as a “man you have sex with but do not feel committed to or don't know very well," an exchange partner was defined as a "man you have sex with in exchange for things like money or drugs." Considering what is most biologically relevant to HIV status among heterosexual women, oral sex and protected vaginal or anal sex using a condom were not considered. The following six sexual behavior variables were considered:

- Number of main unprotected vaginal sex partners last 12 months.
- Number of casual unprotected vaginal sex partners last 12 months.
- Number of exchange unprotected vaginal sex partners last 12 months.
- Number of main unprotected anal sex partners last 12 months.
- Number of casual unprotected anal sex partners last 12 months.
- Number of exchange unprotected anal sex partners last 12 months.

After further consideration, it was decided that the number of unprotected sex partners likely likes in the hypothesized causal pathway and that they therefore should not be controlled for in the model analyses.

Inclusion/Exclusion Criteria

Analyses were limited to black female NHBS-HET1 respondents. The age range for participation in NHBS-HET1 was 18-50 years.

Modeling Approach

While the outcome (HIV status) and potential modifier and confounder data are cross-sectional at the individual level, the exposure data (i.e., community sex ratios) are cross-sectional at the county level. Therefore, multilevel data analytic techniques are warranted in order to consider the multilevel aspects of the combined datasets. That is, since there is potential clustering within counties for the community sex ratio analysis, hierarchical models were developed to assess the outcome and exposures of interest and potential modifiers and confounders discussed above (7). In other words, the sex ratios were treated as predictor variables in different models and no more than one Level 2 exposure was included in each model. The “cluster” for the community sex ratio analyses was the county.

<u>Descriptive Statistics</u>

Descriptive statistics were calculated for the dependent and independent variables. These descriptive statistics include cross-tabulations of the outcome variable (HIV infection) with different versions of the community sex ratio. Cross-tabulations were also run between HIV infection and individual level variables.

<u>Data Layout</u>

Table 2 presents a sample data layout for the community sex ratio analyses. The columns include county, a study ID for each participant, the outcome (HIV status) for each participant, the overall male:female sex ratio, 18-44 in each county, participant age, and participant income. In the interest of brevity, only three counties and two potential individual level effect modifiers or confounders are presented.

Table 2. Sample Data Layout for Community Sex Ratio Analyses

County	**Study ID**	**HIV status**	**Overall male: female sex ratio, 18-44**	**Age**	**Income**	**…**
Fulton County (GA)	1001	0	104.5	18	3	**…**
Fulton County (GA)	1002	1	104.5	23	2	**…**
Fulton County (GA)	1003	0	104.5	36	1	**…**
Fulton County (GA)	1004	0	104.5	48	0	**…**
Fulton County (GA)	1005	0	104.5	22	1	**…**
…	**…**	**…**	**…**	**…**	**…**	**…**
Cook County (IL)	7001	0	98.3	33	2	**…**
Cook County (IL)	7002	0	98.3	44	0	**…**
Cook County (IL)	7003	0	98.3	19	2	**…**
Cook County (IL)	7004	0	98.3	28	1	**…**
Cook County (IL)	7005	0	98.3	21	1	**…**
…	**…**	**…**	**…**	**…**	**…**	**…**
Essex County (NJ)	16001	0	102.4	41	0	**…**
Essex County (NJ)	16002	0	102.4	26	1	**…**
Essex County (NJ)	16003	0	102.4	18	3	**…**
Essex County (NJ)	16004	0	102.4	39	1	**…**
Essex County (NJ)	16005	1	102.4	28	2	**…**
…	**…**	**…**	**…**	**…**	**…**	**…**

NOTE: Numbers included in this table were contrived solely for the purposes of this example.

Modeling Procedures

Model analyses were performed using SAS® version 9.2. Models are in the logistic form. The SAS® GENMOD procedure was used to fit generalized quasi-likelihood models. This is a simplified form of a multilevel model that does not allow the researcher to distinguish between predictors measured at the community level and others measured at the individual level. Therefore, the GLIMMIX procedure was also used to account for random effects resulting from the concatenation of the multiple levels. The use of GLIMMIX allows one to distinguish between predictors measured at the community level and others measured at the individual level. GENMOD and GLIMMIX model results were compared. Since the analyses were performed using cross-sectional correlated data rather than longitudinally correlated data, models were fit with an exchangeable correlation structure.

Correlation of all independent variables with the dependent variable was assessed for the overall samples. Correlation was also assessed for different strata of the community sex ratios. In addition, simple logistic regression models were run to assess the association between HIV status, each exposure of interest, and each individual level variable alone and controlling for all other individual level variables. Next, collinearity was evaluated using condition indices (cut point = 30) and variance decomposition proportions (cut point = 0.50) (8). Interaction was then assessed using the variables remaining after the previously described assessments. "Chunk" tests were performed using the Wald and score tests. After the "chunk" test, manual backward elimination was performed using the score test, dropping the most insignificant interaction terms, in order, to see if any of the remaining interaction terms were significant. Once a "gold standard" model was established, confounding was assessed using a "10% difference rule (8)." Precision assessments based on the width of confidence intervals were also conducted.

Starting Models

The models presented in this section represent the models remaining after collinearity and interaction were assessed.

The following starting GENMOD model was considered for the community sex ratio analyses (using the overall male:female sex ratio, 0+ for demonstration purposes):

logit P(newhivstatus=1)= $\beta 0 + \beta 1(\text{sexratio0}) + \beta 2(\text{agecat}) + \beta 3(\text{newincome}) + \beta 4(\text{newschool}) + \beta 5(\text{newemploy}) + \beta 6(\text{homeless}) + \beta 7(\text{f\_mljail})$

where: sexratio0 = overall male:female sex ratio, 0+

agecat = age (ordinal)

newincome = annual household income

newschool = educational attainment

newemploy = employment status

homeless = current housing status

f_mljail = last male sex partner spent more than 24 hours in jail or prison

The starting GLIMMIX model, including a random intercept and no random slopes, considered for the community sex ratio analyses (using the overall male:female sex ratio, 0+ as an example) was:

Level 1:

logit P(newhivstatus$_{ij}$=1, **X**) = $\beta_{0j} + \beta_{1j}(\text{agecat})_{ij} + \beta_{2j}(\text{newincome})_{ij} + \beta_{3j}(\text{newschool})_{ij} + \beta_{4j}(\text{newemploy})_{ij} + \beta_{5j}(\text{homeless})_{ij} + \beta_{6j}(\text{f\_mljail})_{ij}$

Level 2:

$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{sexratio0})_j + u_{0j}$

$\beta_{1j} = \gamma_{10} + \gamma_{11}(\text{sexratio0})_j$

$\beta_{2j} = \gamma_{20} + \gamma_{21}(\text{sexratio0})_j$

$\beta_{3j} = \gamma_{30} + \gamma_{31}(\text{sexratio0})_j$

$\beta_{4j} = \gamma_{40} + \gamma_{41}(\text{sexratio0})_j$

$\beta_{5j} = \gamma_{50} + \gamma_{51}(\text{sexratio0})_j$

$\beta_{6j} = \gamma_{60} + \gamma_{61}(\text{sexratio0})_j$

where:

i = county resident *i*

j = county *j*

u_{0j} = random intercept for county *j*

All other variables are as described above.

Combining Levels 1 and 2

$$
\begin{aligned}
\text{logit } P(\text{newhivstatus}_{ij}=1, \mathbf{X}) = \quad & (\gamma_{00} + \gamma_{01}(\text{sexratio0})_j + u_{0j}) + \\
& (\gamma_{10} + \gamma_{11}(\text{sexratio0})_j)(\text{agecat})_{ij} + \\
& (\gamma_{20} + \gamma_{21}(\text{sexratio0})_j)(\text{newincome})_{ij} + \\
& (\gamma_{30} + \gamma_{31}(\text{sexratio0})_j)(\text{newschool})_{ij} + \\
& (\gamma_{40} + \gamma_{41}(\text{sexratio0})_j)(\text{newemploy})_{ij} + \\
& (\gamma_{50} + \gamma_{51}(\text{sexratio0})_j)(\text{homeless})_{ij} + \\
& (\gamma_{60} + \gamma_{61}(\text{sexratio0})_j)(\text{f\_mljail})_{ij}
\end{aligned}
$$

ANALYSES OF PERCEIVED AND STRUCTURAL DISCRIMINATION AGAINST MSM

This section describes the methods employed to answer the following two research questions:

2. Is perceived discrimination against gay and bisexual men associated with HIV status among these men?
3. Is structural discrimination against MSM associated with HIV status among these men?

For both sets of analyses, the outcome of interest was HIV status. All individual level variables, including HIV status, were derived from the second MSM iteration of the NHBS (NHBS-MSM2). Data for the first exposure of interest – perceived discrimination against gay and bisexual men – were derived from an original online survey that I developed and implemented. Data for the second exposure of interest – structural discrimination against MSM – were compiled – based on various sources – into a novel composite structural discrimination index (SDI).

Data Source: NHBS-MSM2

As discussed above, CDC awarded supplemental funds to state and local health departments to develop and implement the NHBS to monitor behaviors that place people at risk for HIV infection. NHBS-MSM2 data collection was conducted in 2008 (9). In 2008, there were 21 MSAs and Metro Divisions instead of 25. The eligible jurisdictions for NHBS-MSM2 were slightly different from those for NHBS-HET1. These MSAs and Metro Divisions represent 66% of urban AIDS prevalence in the US (9). Each grantee enrolled at least 500 MSM per MSA or Metro Division (9).

NHBS-MSM2 was a repeated cross-sectional survey of men who attend MSM-identified venues in defined geographic areas. Survey methods were based on an application of time-space sampling that has proven successful in obtaining large and diverse samples of MSM (9). To be included in the NHBS-MSM2 sample, a respondent had to be male; at least 18 years old; and live in a participating MSA (9-13). The original objectives of NHBS-MSM2 were to assess the prevalence of, and trends in, sexual and drug use risk behaviors and HIV testing behaviors; assess exposure to, and use of, prevention services; and assess HIV seroprevalence and behaviors associated with HIV serostatus (9).

Outcome of Interest: HIV Status

The outcome variable for the perceived and structural discrimination analyses was HIV infection (yes (=1)/no(=0)). Not all eligible respondents self-reported their HIV status as part of the survey. Others did not assent to HIV testing. In addition, among some of the respondents who did assent to HIV testing, a definitive test result (i.e., positive or negative) was not available. Therefore, HIV status was based on a combination of self-reported status and the results of HIV tests administered during the NHBS-HET1 survey. Preference was given to test results. In other words, if a person reported being HIV-negative but test results showed them to be HIV-positive, then that respondent was considered HIV-positive. Only respondents with a known value for HIV status (positive or negative) were included in the analyses. Those for whom final HIV status was “unknown,” “indeterminate,” or “missing” were excluded.

Concordance between the two ways of measuring HIV status – testing and self-report – was assessed. Among all NHBS-MSM2 respondents who self-reported HIV status as negative, 92.3% tested negative and 7.4% tested positive. Of those NHBS-MSM2 respondents who reported being HIV-positive, 89.1% tested positive and 5.5% tested negative. The percentages may not total 100% because some respondents were classified as “unknown,” “indeterminate,” or “missing.”

Exposure of Interest: Perceived Discrimination against Gay and Bisexual Men

Previous research has shown that perceptions of discrimination and other psychosocial factors affect the sex-seeking and sexual behaviors of different populations, including MSM, at the individual level (14-21). However, no studies published to date have evaluated the association of prevalent HIV infection at the individual level among gay and gay bisexual men with perceptions of discrimination among such men. While NHBS-MSM2 collected detailed information on behavioral risk factors and HIV prevalence among MSM throughout the US, it does not provide information on experienced or perceived discrimination. Therefore, I proposed to conduct a survey of perceptions of discrimination among MSM which could serve as a first step toward the regular collection of information on perceptions of discrimination against gay and bisexual men and evaluation of the association of these perceptions with the occurrence of HIV among MSM.

The Internet is growing in importance as a tool for epidemiologic research (22). Therefore, I decided to recruit for, and conduct, my survey online. Once this decision was made, it was important to assess which avenues of Internet-based recruitment and survey implementation would be practical and cost-effective while still yielding valid results.

Internet use and broadband access are both positively associated with income (22). Use of the Internet trends from 63% of adults with a household income less than $30,000 annually to 95% of adults with an annual household income of $75,000 or more (23). In terms of broadband Internet access, the income divide is even starker, increasing from 45% among those with annual household incomes of less than $30,000 to 67% in the $30,000 to $49,999 range, 79% in the $50,000 to $74,999 range, and 87% among those with household incomes of $75,000 or greater per year (24).

Among those adults who have a social network profile, 73% have a profile on Facebook, 48% on MySpace, and 14% on LinkedIn (25). While ownership of a Facebook profile is relatively similar among adult profile owners with annual household income more or less than $50,000 per year (77% vs. 71%), ownership of a MySpace profile is negatively associated with income (25). That is, adult profile owners with an annual household income less than $50,000 per year are significantly more likely to have a MySpace profile (64%) than are adult profile owners with an annual household income more than $50,000 (36%) (25).

In addition, while not the case in all geographic areas or among all MSM subpopulations, coupled MSM in the geographic areas covered by NHBS-MSM2 tend to be on the upper side of the income divide. In large metropolitan areas (population of 1,000,000 or more), the percentage among poor householders and partners is lower for male couples (3.3%) than for married different-sex couples (5.1%) (26). This difference, while not statistically significant, is also seen in medium-sized metropolitan areas (population of 250,000 to 1,000,000) – 4.4% among male couples and 5.0% among married different-sex couples (26). Considering the overall popularity of Facebook as well as the relationship between income and social networking site use, I decided to conduct all survey recruitment via the placement of banner ads on Facebook.

For study power and sample size, several factors had to be considered, including the overall population size of all the MSAs and Metro Divisions of potential interest; the size and proportion of the MSM population in the MSAs and Metro Divisions of potential interest; and the total number of people in general and MSM specifically living with HIV as well HIV prevalence among the general and MSM populations in each of the MSAs and Metro Divisions of potential interest. Taking into account these factors, I endeavored to recruit a minimum of 1,500 men ages 18 years and older living in one of 20 MSAs or Metro Divisions (minimum 75 per area) included in NHBS-MSM2. The MSAs and Metro Divisions are listed in Table 3.

Table 3. MSAs and Metro Divisions Considered for Perceived Discrimination Analyses

	MSA/Metro Division	State*	Male Same-Sex Couples in Metropolitan Area, 2005 (27)	NHBS-MSM2 Respondents in MSA/Metro Division
1	Atlanta MSA	GA	2,905	371
2	Baltimore MSA	MD	1,601	535
3	Boston Metro Division	MA	2,755	293
4	Chicago Metro Division	IL	6,218	607
5	Dallas Metro Division	TX	3,550	537
6	Denver MSA	CO	1,488	590
7	Detroit MSA	MI	691	416
8	Houston MSA	TX	3,926	483
9	Los Angeles Metro Division	CA	7,313	558
10	Miami Metro Division	FL	697	545
11	Nassau-Suffolk Metro Division	NY	--	301
12	Newark Metro Division	NJ	--	106
13	New Orleans MSA	LA	949	515
14	New York Metro Division	NY	13,655	553
15	Philadelphia Metro Division	PA	1,575	573
16	St. Louis MSA	MO	1,353	406
17	San Diego MSA	CA	3,700	584
18	San Francisco Metro Division	CA	6,233	514
19	Seattle Metro Division	WA	3,324	382
20	Washington, DC, Metro Division	DC	2,319	521

*Since some MSAs or Metro Divisions span more than one state, this refers to the "predominant" state for each MSA or Metro Division.

The MSAs and Metro Divisions listed in Table 3 represent a total sample size of 9,390.

Survey Recruitment

Banner advertisements announcing the survey were displayed at random times of day to Facebook users whose profiles indicated that they are 18 years or older, male, interested in men, and reside within a 50-mile radius of the main cities of 20 MSAs and Metro Divisions of interest. As of November 4, 2011, Facebook estimated an "ad reach" of 256,340 Facebook users based on these criteria. The banner advertisements consisted of non-sexually explicit graphics with brief descriptive text. Figures 2-8 depicts the banner advertisements used.

Figure 2. Banner Advertisement #1

Figure 3. Banner Advertisement #2

Figure 4. Banner Advertisement #3

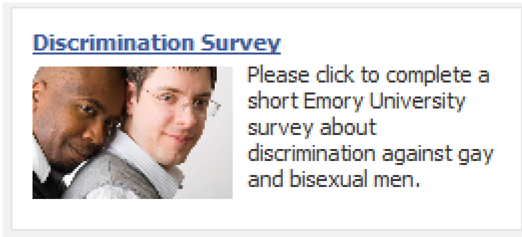


Figure 5. Banner Advertisement #4

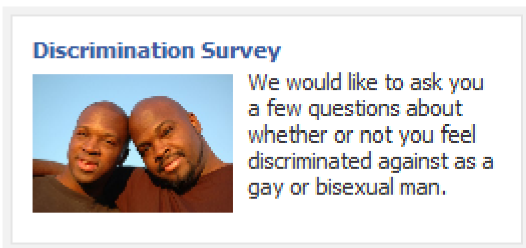


Figure 6. Banner Advertisement #5

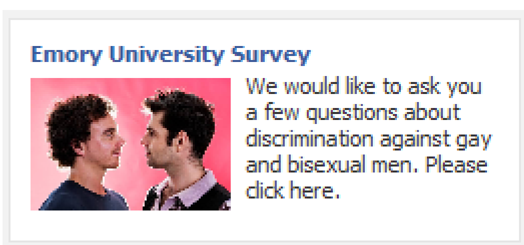


Figure 7. Banner Advertisement #6

Figure 8. Banner Advertisement #7

Survey Administration

Potential participants who clicked on the banner advertisements were taken to a Web site with a set of four eligibility questions. Eligibility was determined based on the following criteria:

- Age (18 years or older).
- Sex (male).
- Had at least one male sex partner in past 12 months (yes).
- City of residence (main city of one of 20 MSAs or Metro Divisions of interest).

Respondents who were not eligible based on their answers to the screening questions were directed to a screen thanking them for their interest. Those eligible to participate in the study were directed to the informed consent module. Respondents were required to read the informed consent document before indicating whether or not they consented. This was enforced by requiring participants to scroll through the entire consent document before being able to consent to the study. Consent or lack thereof was documented in the electronic database by the stored variable indicating consent or lack of consent. A button allowing participants to print the consent form for their records was located at the end of the consent form document.

Those who consented to participate were administered the online survey. Initial questions included:

- What is your race?
- Do you consider yourself to be Hispanic or Latino?
- Do you have a main male partner?
- If yes, what is the status of your relationship with your main male partner?

Next, respondents answered 16 questions about perceptions of discrimination in the city or town in which they live. These questions were answered on a five-point Likert scale ranging from “strongly disagree” to “strongly agree.” Finally, respondents were asked whether or not they were living in the same city or town as they are today and were then asked the same 16 questions about perceptions of discrimination four years ago.

Survey Scoring

The main questions of interest were the 16 questions regarding perceptions of discrimination. All other questions were used either to characterize the sample or for other analyses. As discussed above, questions related to perceptions of discrimination were answered and scored on a five-point Likert scale. Based on the tenor of the question, the scale was adjusted so that a higher number reflects higher perceived discrimination. For instance, the question reading, “Most employers in my city/town will hire a gay/bisexual man if he is qualified for the job” was scored using the Likert scale, as follows:

- 5 – Strongly disagree.
- 4 – Disagree.
- 3 – Neutral.
- 2 – Agree.
- 1 – Strongly agree.

On the other hand, the question, “Most people in my city/town think less of a person who is gay/bisexual” was scored, as follows:

- 1 – Strongly disagree.
- 2 – Disagree.
- 3 – Neutral.
- 4 – Agree.
- 5 – Strongly agree.

Survey results were extracted into a single score for each respondent and an average score was calculated for MSM in each MSA or Metro Division. Because of decreased response rates, the Nassau-Suffolk (NY) and Newark (NJ) Metro Divisions were combined with the New York City Metro Division, leaving a total of 18 areas for which area-level scores were calculated. These area-level scores were then merged with the NHBS-MSM2 dataset. The perceived discrimination score was included in the analysis as continuous at the level of the MSA or Metro Division. For the purposes of descriptive statistics, comparisons were drawn between men living in communities with high perceived discrimination and those living in communities with low perceived discrimination.

Exposure of Interest: Index of Structural Discrimination against MSM

Research to determine the existence and extent of laws and policies affecting gay and bisexual men as well as regulating same-sex partnerships and adoption included Internet searches and the review of state and municipal legal codes and employer policies (where available). Since many of the relevant laws and policies emanate from the state level, I decided to combine a number of state level measures (28). The measures included in the SDI were:

- Hate crime laws.
- Housing discrimination laws.

- Employment discrimination laws.
- Marriage and other relationship recognition (or bans).
- Adoption laws.

To the extent possible, all laws and policies were reviewed to determine whether or not they were in effect at the time NHBS-MSM2 was conducted and the HIV status of individual participants determined – 2008. Development of the specific components of the index and the overall SDI score are discussed below. For the coding of the SDI, I wanted higher scores to represent hypothesized higher structural discrimination. Therefore, the individual components of the SDI as well as the overall index were coded such that higher scores equate to higher hypothesized structural discrimination.

Hate Crime Laws

As of 2008, 31 states and DC had laws addressing hate or bias crimes based on sexual orientation (28). Of the 15 states and DC accounted for by the 20 MSAs and Metro Divisions of interest, only two (Georgia and Pennsylvania) did not have laws addressing hate or bias crimes based on sexual orientation (28). As of 2011, these two states had not added such laws to their books (28). The presence or absence of hate crimes laws based on sexual orientation was coded as:

- No law on books that addresses hate crimes based on sexual orientation (=1).
- Law on books that addresses hate crimes based on sexual orientation (=0).

Housing Laws and Policies

Twenty states and DC prohibit housing discrimination based sexual orientation (28). Six of the 15 states and DC (37.5%) associated with the MSAs and Metro Divisions of interest did not have a law or policy prohibiting such discrimination (28). The presence or absence of housing discrimination regulations was coded as:

- No law or policy prohibiting housing discrimination based on sexual orientation (=1).
- Law or policy prohibiting housing discrimination based on sexual orientation (=0).

Employment Discrimination Laws and Policies

As of 2008, 20 states and DC banned employment discrimination based on sexual orientation (28). Delaware instituted a law prohibit sexual orientation-based employment discrimination in 2009 (28). Eight of the 15 states and DC related to the 20 MSAs and Metro Divisions of interest had a law or policy banning employment discrimination based on sexual orientation in 2008 (28). This number had not increases as of 2011 (28). The presence or absence of laws and policies banning housing discrimination was coded as:

- No law or policy in place banning employment discrimination based on sexual orientation (=1).

- Law or policy in place that bans employment discrimination based on sexual orientation (=0).

Same-Sex Partnerships and Relationship Recognition Laws

As discussed above, the recognition, or lack thereof, of same-sex partnerships takes on several forms. For instance, some states issue marriage licenses to same-sex couples while others have passed constitutional amendments or state laws restricting marriage to one man and one woman. The remaining states fall somewhere between these two ends of the spectrum. Reflecting this spectrum, the component SDI for same-sex partnerships takes into account several factors. These include the granting of actual marriage licenses to same-sex couples; the provision of equivalent spousal rights to same-sex couples; and the provision of some statewide spousal rights to same-sex couples. In addition, some states offer some form of recognition to out-of-jurisdiction marriage licenses, registered civil unions or domestic partnerships (28).

First, 11 of the 15 states (and DC) of interest (68.8%) have a constitutional amendment or law restricting marriage to one man and one woman (28). If the steps have been taken to incorporate such a restriction in a state's constitution, it was considered to evince greater structural discrimination than the passage of a related law. This component of the index was coded as:

- Constitutional amendment restricting marriage to one man and one woman (=2).

- State law restricting marriage to one man and one woman (=1).
- No express prohibition of same-sex marriage (=0).

In 2008, two states (Connecticut and Massachusetts) issued marriage licenses to same-sex couples (28). By the beginning of 2011, three states (Iowa, New Hampshire, and Vermont) and DC were issuing such licenses (28). New York began doing so in July 2011 (28). As of 2008, California, New Jersey, Oregon, and Washington provided equivalent state-level spousal rights to same-sex couples (28). Since then, Illinois, Nevada, and Rhode Island have initiated such recognition (28). Finally, Maine began providing some spousal rights to same-sex couples in 2004 while Colorado and Wisconsin did so in 2009 (28). The recognition of same-sex partnerships were incorporated into the SDI as:

- No express recognition of same-sex partnerships (=3).
- Extension of some rights to same-sex couples (=2).
- Extension of equivalent rights to same-sex couples (=1).
- Issuance of marriage licenses to same-sex couples (=0).

<u>Joint Adoption Laws</u>

As of 2008, six states and DC of the 15 states (and DC) linked with the MSAs and Metro Divisions (46.7%) explicitly allowed same-sex couples to petition jointly to adopt (28). Same-sex couple adoption rights were incorporated into the SDI as:

- Same-sex couples not explicitly allowed to petition jointly to adopt (=1).
- Same-sex couples explicitly allowed to petition jointly to adopt (=0).

A state was assigned to an MSA or Metro Division based on the MSA or Metro Division's main city. While the "Level 2" data are at the state level, individual level data are based on MSAs and Metro Divisions as described for the perceived discrimination analyses. This was done to keep the individual level data as consistent as possible across the different sets of analyses. The MSAs and Metro Divisions included in the analyses were presented in Table 3. Table 4 presents the component and overall SDI scores for each MSA and Metro Division and their respective states. The overall SDI was calculated by summing the scores for the individual components. It ranges from a minimum of 0 to a maximum of 9. A higher SDI indicates higher hypothesized structural discrimination. The components scores for same-sex partnership recognition and same-sex marriage prohibition were also examined as an exposure of interest.

Table 4. Overall and Component SDI Scores by MSA/Metro Division and State, 2008

MSA/ Metro Division	Hate Crimes	Housing	Employ-ment	Marriage Restricted	Same-Sex Partners	Joint Adoption	Overall SDI
Atlanta	1	1	1	2	3	1	**9**
Baltimore	0	0	0	1	3	1	**5**
Boston	0	0	0	0	0	0	**0**
Chicago	0	0	0	1	3	0	**4**
Dallas	0	1	1	2	3	1	**8**
Denver	0	0	0	2	3	1	**6**
Detroit	0	1	1	2	3	1	**8**
Houston	0	1	1	2	3	1	**8**
Los Angeles	0	0	0	2	1	0	**3**
Miami	0	1	1	2	3	1	**8**
Nassau-Suffolk	0	0	0	0	3	0	**3**
Newark	0	0	0	0	1	0	**1**
New Orleans	0	1	1	2	3	1	**8**
New York	0	0	0	0	3	0	**3**
Philadelphia	1	1	1	1	3	1	**8**
St. Louis	0	0	1	2	3	1	**7**
San Diego	0	0	0	2	1	0	**3**
San Francisco	0	0	0	2	1	0	**3**
Seattle	0	0	0	0	1	0	**1**
Washington, DC	0	0	0	0	3	0	**3**

One overall SDI score was calculated for each combination of state and MSA or Metro Division. These scores were then merged with the NHBS-MSM2 dataset. The SDI was included in the model analyses as ordinal at the state level. For the purposes of descriptive statistics, comparisons were drawn between men living in communities with high hypothesized structural discrimination and those living in communities with low hypothesized structural discrimination.

Potential Individual Level Effect Modifiers and Confounders

Data on all individual level factors were derived from NHBS-MSM2. While some of the individual level variables remaining after the correlation and collinearity assessments were examined as potential effect modifiers, all were included as potential confounders. To the extent possible, individual variables were coded so that the highest number corresponded to the highest theorized probability of positive HIV status. The individual level variables considered are described below.

<u>Age</u>

Age was specified as:

- 60+ (=6).
- 50-59 (=5).
- 40-49 (=4).
- 35 to 39 (=3).
- 30 to 34 (=2).
- 25 to 29 (=1).
- 18 to 24 (=0).

<u>Race/Ethnicity</u>

Race/ethnicity was operationalized as:

- Black, not Hispanic (=3).
- Hispanic (=2).
- Other [American Indian, Alaska Native, Native Hawaiian/Pacific Islander, Other, Multiracial] (=1).
- White, not Hispanic (=0).

Income

Annual household income was categorized, to the extent possible, on the distribution in the sample population. It was stratified into the following groups:

- $0 to $14,999 (=3)
- $15,000 to $39,999 (=2)
- $40,000 to $74,999 (=1)
- $75,000 or more (=0)

Employment Status

Based on the relevant NHBS-HET1 question, employment status was categorized as:

- Unemployed, retired, disabled for work, or other (=1).
- Employed full-time or part-time, homemaker, or full-time student (=0).

Respondent Drug Use

Respondent non-injection drug use was specified as:

- Used non-injection drugs past 12 months (=1).
- Did not use non-injection drugs past 12 months (=0).

Sexual Identity and Level of Outness

Data on a man's sexual identity and level of outness were derived from the NHBS-MSM2 survey. First, survey respondents were asked if they considered themselves to be heterosexual or "straight;" homosexual or gay; or bisexual. Men identifying as homosexual, gay, or bisexual were grouped as "gay identified" while those considering themselves to be heterosexual or straight were grouped as "non-gay identified." These men were then asked if they have ever told anyone that they are attracted to or have sex with men. They were also asked which of the following groups of people they have told that they are attracted to or have sex with men:

- Gay, lesbian, or bisexual friends.
- Friends who are not gay, lesbian, or bisexual.
- Family members, including spouse or partner if not gay-identified.
- HCP.

These groups can be construed as comprising a “gradient of outness” based on the presumed level of interpersonal comfort associated with being out to different groups of people. While being non-gay identified and out to nobody could be considered “least” out, being gay-identified and out to a HCP could be considered “most” out. Based on the hypothesis that a lower level of outness is associated with a higher level of psychological distress and thus a higher propensity to participate in risky sexual situations, an outness “score” was developed so that the highest possible score was associated with the highest hypothesized risk of HIV infection and the lowest possible score was associated with the lowest hypothesized risk of HIV. Structured as such, the outness score accounted for both the gradient of outness and the number of groups on this gradient to which a man is out.

However, preliminary analyses indicated that the outness score did not perform as hypothesized relative to HIV status. Therefore it was decided to include self-identified sexuality and a general measure of outness to others, regardless of self-identified sexuality, instead of the outness score. Self-identified sexuality was operationalized as:

- Bisexual (=2).
- Homosexual or gay (=1).
- Heterosexual or straight (=0).

Outness to others was specified as:

- Told anyone attracted to or have sex with men (=1).
- Not told anyone attracted to or have sex with men (=0).

Other Sexually Transmitted Infections

Other STIs such as syphilis, gonorrhea, or chlamydia are often found in persons with HIV. Importantly, the presence of certain STIs may render a person more vulnerable to HIV acquisition. For the purposes of the current analyses, however, it was determined that other STIs lie in the hypothesized causal pathway and should therefore not be controlled for in the model analyses.

Number and Type of Sex Partners

Respondents were asked how many main, casual, and exchange sex partners they had in the past 12 months. These terms are defined above. Considering what is most biologically relevant to HIV status among MSM, oral sex or protected anal sex using a condom were not considered. The following continuous variables were considered:

- Number of main unprotected anal sex partners last 12 months.
- Number of casual unprotected anal sex partners last 12 months
- Number of exchange unprotected anal sex partners last 12 months.

However, since the number of unprotected sex partners is most likely in the hypothesized causal pathway, these variables were not controlled for in the model analyses.

Inclusion/Exclusion Criteria

Perceived discrimination survey respondents were limited to men ages 18 years of age and older who lived within 50 miles of the main city of the relevant MSA or Metro Division and reported having at least one male sexual partner in the past 12 months. NHBS-MSM2 respondents were limited to men ages 18 years of age and older living within the sampling frames of each MSA or Metro Division.

Modeling Approach

While the outcome (HIV status) and potential modifier and confounder data are cross-sectional at the individual level, the exposure data (i.e., perceived discrimination, structural discrimination) are cross-sectional at the Metro Division or MSA level. Therefore, multilevel data analytic techniques are warranted in order to consider the multilevel aspects of the combined datasets. That is, since there is potential clustering within MSAs or Metro Divisions for the perceived discrimination scores and the structural discrimination indices, hierarchical models were developed to assess the outcome and exposures of interest and potential modifiers and confounders discussed above (7). In other words, the aggregated perceived discrimination scores and the structural discrimination indices were treated as predictor variables in different models and no more than one Level 2 exposure was included in each model. The cluster for all correlated analysis was the MSA or Metro Division.

Descriptive Statistics

Descriptive statistics were calculated for the dependent and independent variables. These descriptive statistics include cross-tabulations of the outcome variable (HIV infection) with perceived discrimination among MSM and the level of structural discrimination against MSM. Cross-tabulations were also run to explore the relationships between HIV infection and individual level variables.

Data Layout

Similar data layouts were used for the perceived and structural discrimination analyses. Tables 5 and 6 present sample data layouts for the perceived discrimination and structural discrimination analyses. Table 5 includes columns for MSA or Metro Division, a study ID for each participant, the outcome (HIV status) for each participant, the perceived discrimination score for each MSA or Metro Division, employment status for each participant, and a value for outness to others for each participant. In the interest of brevity, only three MSAs and Metro Divisions and two potential individual level effect modifiers or confounders are presented.

Table 5. Sample Data Layout for Perceived Discrimination Analyses

MSA/ Metro Division	**Study ID**	**HIV status**	**Perceived Discrim-ination**	**Employ-ment**	**Out to Others**	**…**
Atlanta	1001	0	43.03	1	1	**…**
Atlanta	1002	1	43.03	1	0	**…**
Atlanta	1003	0	43.03	0	1	**…**
Atlanta	1004	1	43.03	1	0	**…**
Atlanta	1005	0	43.03	1	1	**…**
…	**…**	**…**		**…**	**…**	**…**
Philadelphia	13001	1	42.67	0	1	**…**
Philadelphia	13002	0	42.67	0	0	**…**
Philadelphia	13003	0	42.67	1	0	**…**
Philadelphia	13004	0	42.67	1	1	**…**
Philadelphia	13005	0	42.67	1	0	**…**
…	**…**	**…**		**…**	**…**	**…**
Seattle	17001	0	36.22	1	1	**…**
Seattle	17002	0	36.22	1	1	**…**
Seattle	17003	1	36.22	1	1	**…**
Seattle	17004	0	36.22	1	0	**…**
Seattle	17005	0	36.22	1	0	**…**
…	**…**	**…**	**…**	**…**	**…**	**…**

NOTE: Numbers included in this table were contrived solely for the purposes of this example.

For Table 6, the columns include MSA or Metro Division, a study ID for each participant, the outcome (HIV status) for each participant, the overall SDI in 2008 for each MSA or Metro Division, and the age and race of each participant. For the sake of brevity, only three MSAs or Metro Divisions and two potential individual level effect modifiers or confounders are presented.

Table 6. Sample Data Layout for Structural Discrimination Analyses

MSA/ Metro Division	Study ID	HIV status	Overall SDI, 2008	Age	Race	…
Dallas	1001	1	43.03	6	2	…
Dallas	1002	0	43.03	3	0	…
Dallas	1003	0	43.03	3	2	…
Dallas	1004	0	43.03	2	0	…
Dallas	1005	0	43.03	1	3	…
…	…	…		…	…	…
Miami	13001	0	42.67	5	3	…
Miami	13002	0	42.67	3	0	…
Miami	13003	0	42.67	4	0	…
Miami	13004	1	42.67	1	2	…
Miami	13005	0	42.67	2	2	…
…	…	…		…	…	…
San Francisco	17001	0	36.22	1	1	…
San Francisco	17002	0	36.22	0	3	…
San Francisco	17003	0	36.22	0	0	…
San Francisco	17004	1	36.22	5	0	…
San Francisco	17005	1	36.22	3	3	…
…	…	…	…	…	…	…

NOTE: Numbers included in this table were contrived solely for the purposes of this example.

Modeling Procedures

Model analyses were performed using SAS® version 9.2. Models are in the logistic form. The SAS® GENMOD procedure was used to fit generalized quasi-likelihood models. This is a simplified form of a multilevel model that does not allow the researcher to distinguish that some predictors are measured at the community level while others are measured at the individual level. Therefore, the GLIMMIX procedure was also used to account for random effects resulting from the concatenation of the multiple levels. The use of GLIMMIX allows one to distinguish between predictors measured at the community level and others measured at the individual level. GENMOD and GLIMMIX model results were compared. Since the analyses were performed using cross-sectional correlated data rather than longitudinally correlated data, models were fit with an exchangeable correlation structure.

Correlation of all independent variables with the dependent variable was assessed. In addition, simple logistic regression models were run to assess the association between HIV status, each exposure of interest, and each individual level variable alone and controlling for all other individual level variables. Next, collinearity was evaluated using condition indices (cut point = 30) and variance decomposition proportions (cut point = 0.50). Interaction was then assessed using the variables remaining after the previously described assessments. "Chunk" tests were performed using the Wald and score tests. After the "chunk" test, manual backward elimination was performed using the score test, dropping the most insignificant interaction terms, in order, to see if any of the remaining interaction terms were significant. Once a "gold standard" model was established, confounding was assessed using a "10% difference rule." Precision assessments based on the width of confidence intervals were also conducted.

Starting Models

The models presented in this section represent the models remaining after collinearity and interaction were assessed.

The following starting GENMOD model was considered for the perceived discrimination analyses (using PDall as an example) was:

$$\text{logit } P(HIV=1)= \beta 0 + \beta 1(PDall) + \beta 2(agecat) + \beta 3(newrace) + \beta 4(newincome) + \beta 5\ (newemploy2) + \beta 6(niuse12) + \beta 7(outother)$$

<u>where</u>: PDall = overall perceived discrimination score

agecat = age (ordinal)

newrace = race/ethnicity

newincome = annual household income

newemploy2 = employment status

niuse12 = non-injection drug use past 12 months

outother = told anyone attracted to or have sex with men

The starting GLIMMIX model, including only a random intercept, considered for the perceived discrimination analysis (using PDall for demonstration purposes) was:

$$\text{logit } P(newhivstatus_{ij}=1, \mathbf{X}) = \beta_{0j} + \beta_{1j}(agecat)_{ij} + \beta_{2j}(newrace)_{ij} + \beta_{3j}(newincome)_{ij} + \beta_{4j}(newemploy2)_{ij} + \beta_{5j}(niuse12)_{ij} + \beta_{6j}(outother)_{ij}$$

<u>Level 2</u>:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(PDall)_j + u_{0j}$$

$\beta_{1j} = \gamma_{10} + \gamma_{11}(\text{PDall})_j$

$\beta_{2j} = \gamma_{20} + \gamma_{21}(\text{PDall})_j$

$\beta_{3j} = \gamma_{30} + \gamma_{31}(\text{PDall})_j$

$\beta_{4j} = \gamma_{40} + \gamma_{41}(\text{PDall})_j$

$\beta_{5j} = \gamma_{50} + \gamma_{51}(\text{PDall})_j$

$\beta_{6j} = \gamma_{60} + \gamma_{61}(\text{PDall})_j$

where: i = MSA/Metro Division resident *i*

j = MSA/Metro Division *j*

u_{0j} = random intercept for county *j*

Combining Levels 1 and 2

$$\begin{aligned}\text{logit } P(\text{newhivstatus}_{ij}=1, \mathbf{X}) = {} & (\gamma_{00} + \gamma_{01}(\text{PDall})_j + u_{0j}) + (\gamma_{10} + \gamma_{11}(\text{PDall})_j)(\text{agecat})_{ij} + \\ & (\gamma_{20} + \gamma_{21}(\text{PDall})_j)(\text{newrace})_{ij} + \\ & (\gamma_{30} + \gamma_{31}(\text{PDall})_j)(\text{newincome})_{ij} + \\ & (\gamma_{40} + \gamma_{41}(\text{PDall})_j)(\text{newemploy2})_{ij} + \\ & (\gamma_{50} + \gamma_{51}(\text{PDall})_j)(\text{niuse12})_{ij} + \\ & (\gamma_{60} + \gamma_{61}(\text{PDall})_j)(\text{outother})_{ij}\end{aligned}$$

The starting GENMOD model considered for the structural discrimination analyses (using overallSDI2008 for demonstration purposes) was:

logit P(HIV=1)= $\beta 0 + \beta 1(\text{overallSDI2008}) + \beta 2(\text{agecat}) + \beta 3(\text{newrace}) + \beta 4(\text{newincome}) + \beta 5(\text{newemploy2}) + \beta 6(\text{niuse12}) + \beta 7(\text{outother}) + \beta 8(\text{overallSDI2008*newemploy2})$

where: overallSDI2008 = overall structural discrimination index

agecat = age (ordinal)

newrace = race/ethnicity

newincome = annual household income

newemploy2 = employment status

niuse12 = non-injection drug use past 12 months

outother = told anyone attracted to or have sex with men

The starting GLIMMIX model, accounting for both a random intercept and random slopes for all Level 1 variables, considered for the structural discrimination analyses (using overallSDI2008 as an example) was:

$$\text{logit } P(\text{newhivstatus}_{ij}=1, \mathbf{X}) = \beta_{0j} + \beta_{1j}(\text{agecat})_{ij} + \beta_{2j}(\text{newrace})_{ij} + \beta_{3j}(\text{newincome})_{ij} + \beta_{4j}(\text{newemploy2})_{ij} + \beta_{5j}(\text{niuse12})_{ij} + \beta_{6j}(\text{outother})_{ij}$$

Level 2:

$\beta_{0j} \quad = \quad \gamma_{00} + \gamma_{01}(\text{overallSDI2008})_j + u_{0j}$

$\beta_{1j} \quad = \quad \gamma_{10} + \gamma_{11}(\text{overallSDI2008})_j$

$\beta_{2j} \quad = \quad \gamma_{20} + \gamma_{21}(\text{overallSDI2008})_j$

$\beta_{3j} \quad = \quad \gamma_{30} + \gamma_{31}(\text{overallSDI2008})_j$

$\beta_{4j} \quad = \quad \gamma_{40} + \gamma_{41}(\text{overallSDI2008})_j$

$\beta_{5j} \quad = \quad \gamma_{50} + \gamma_{51}(\text{overallSDI2008})_j$

$\beta_{6j} \quad = \quad \gamma_{60} + \gamma_{61}(\text{overallSDI2008})_j$

where: i = MSA/Metro Division resident *i*

j = MSA/Metro Division *j*

u_{0j} = random intercept for county *j*.

Interaction terms omitted for sake of brevity.

Combining Levels 1 and 2

$$
\begin{aligned}
\text{logit } P(\text{newhivstatus}_{ij}=1, \mathbf{X}) = \; & (\gamma_{00} + \gamma_{01}(\text{overallSDI2008})_j + u_{0j}) + \\
& (\gamma_{10} + \gamma_{11}(\text{overallSDI2008})_j)(\text{agecat})_{ij} + \\
& (\gamma_{20} + \gamma_{21}(\text{overallSDI2008})_j)(\text{newrace})_{ij} + \\
& (\gamma_{30} + \gamma_{31}(\text{overallSDI2008})_j)(\text{newincome})_{ij} + \\
& (\gamma_{40} + \gamma_{41}(\text{overallSDI2008})_j)(\text{newemploy2})_{ij} + \\
& (\gamma_{50} + \gamma_{51}(\text{overallSDI2008})_j)(\text{niuse12})_{ij} + \\
& (\gamma_{60} + \gamma_{61}(\text{overallSDI2008})_j)(\text{outother})_{ij}
\end{aligned}
$$

REFERENCES

1. Centers for Disease Control and Prevention. National HIV Behavioral Surveillance among Heterosexuals at Risk of HIV Infection (NHBS-HET): Model Surveillance Protocol: NCHHSTP/DHAP/BCSB/Behavioral Surveillance Team; 2006.
2. Gallagher KM, Sullivan PS, Lansky A, Onorato IM. Behavioral surveillance among people at risk for HIV infection in the U.S.: the National HIV Behavioral Surveillance System. Public Health Rep. 2007;122 Suppl 1:32-8.
3. Heckathorn DD. Respondent-driven sampling II: Deriving valid population estimates from chain-referral samples of hidden populations. Social Problems. 2002;49(1):11-34.
4. Heckathorn DD. Respondent-driven sampling: A new approach to the study of hidden populations. Social Problems. 1997;44(2):174-199.
5. Salganik MJ, Heckathorn DD. Sampling and estimation in hidden populations using Respondent-Driven Sampling. Sociol Methodol. 2004;34(1):193-240.
6. Bureau of the Census. An Overview of the American Community Survey. http://www.census.gov/acs/www/guidance_for_data_users/training_presentations. Accessed March 31, 2012.
7. Bingenheimer JB, Raudenbush SW. Statistical and substantive inferences in public health: issues in the application of multilevel models. Annu Rev Public Health. 2004;25:53-77.

8. Kleinbaum DG, Klein M. Logistic Regression: A Self-Learning Text. Third ed. New York: Springer; 2010.

9. Centers for Disease Control and Prevention. National HIV Behavioral Surveillance System: Men Who Have Sex with Men (NHBS-MSM2): Model Surveillance Protocol: NCHHSTP/DHAP/BCSB/Behavioral Surveillance Team; 2008.

10. MacKellar DA, Gallagher KM, Finlayson T, Sanchez T, Lansky A, Sullivan PS. Surveillance of HIV risk and prevention behaviors of men who have sex with men--a national application of venue-based, time-space sampling. Public Health Rep. 2007;122 Suppl 1:39-47.

11. MacKellar D, Valleroy L, Karon J, Lemp G, Janssen R. The Young Men's Survey: methods for estimating HIV seroprevalence and risk factors among young men who have sex with men. Public Health Rep. 1996;111 Suppl 1:138-44.

12. Muhib FB, Lin LS, Stueve A, Miller RL, Ford WL, Johnson WD, et al. A venue-based method for sampling hard-to-reach populations. Public Health Rep. 2001;116 Suppl 1:216-22.

13. Stueve A, O'Donnell LN, Duran R, San Doval A, Blome J. Time-space sampling in minority communities: results with young Latino men who have sex with men. Am J Public Health. 2001;91(6):922-6.

14. Waldo CR, Kegeles SM, Hays RB. Self-acceptance of gay identity predicts decreased sexual risk behavior and increased psychological health in U.S. young gay men. 12th International AIDS Conference. Geneva, Switzerland. 1998.

15. Herek GM, Glunt EK. Identity and community among gay and bisexual men in the AIDS era: preliminary findings from the Sacramento Men's Health Study. In: Herek GM, B. G, editors. Psychological Perspectives on Lesbian and Gay Issues: AIDS, Identity, and Community: The HIV Epidemic and Lesbians and Gay Men. Thousand Oaks, CA: Sage; 1995. p. 55-84.

16. Meyer IH, Dean L. Internalized homophobia, intimacy, and sexual behavior among gay and bisexual men. In: Herek GM, editor. Stigma and Sexual Orientation: Understanding Prejudice Against Lesbians, Gay Men and Bisexuals. Thousand Oaks, CA: Sage; 1998.

17. Stokes JP, Peterson JL. Homophobia, self-esteem, and risk for HIV among African American men who have sex with men. AIDS Educ Prev. 1998;10(3):278-292.

18. Huebner DM, Davis MC, Nemeroff CJ, Aiken LS. The impact of internalized homophobia on HIV preventive interventions. Am J Community Psychol. 2002;30(3):327-48.

19. Diaz RM, Ayala G, Bein E. Sexual risk as an outcome of social oppression: data from a probability sample of Latino gay men in three U.S. cities. Cultur Divers Ethnic Minor Psychol. 2004;10(3):255-67.

20. Preston DB, D'Augelli AR, Kassab CD, Starks MT. The relationship of stigma to the sexual risk behavior of rural men who have sex with men. AIDS Educ Prev. 2007;19(3):218-30.

21. Burchell AN, Calzavara LM, Myers T, Remis RS, Raboud J, Corey P, et al. Stress and increased HIV infection risk among gay and bisexual men. AIDS. 2010;24(11):1757-64.

22. van Gelder MM, Bretveld RW, Roeleveld N. Web-based questionnaires: the future in epidemiology? Am J Epidemiol. 2010;172(11):1292-8.

23. The Pew Internet & American Life Project. Who's online?: demographics of Internet users. http://pewinternet.org/Trend-Data/Whos-Online.aspx. Accessed October 28, 2010.

24. Smith A. Home broadband 2010. http://pewinternet.org/Reports/2010/Home-Broadband-2010.aspx. Accessed March 31, 2012.

25. Lenhart A, Purcell K, Smith A, Zickuhr K. Social media and young adults. http://www.pewinternet.org/Reports/2010/Social-Media-and-Young-Adults.aspx. Accessed October 28, 2010.

26. Albelda R, Badgett MVL, Scheebaum A, Gates G. Poverty in the lesbian, gay, and bisexual community. Los Angeles: The Williams Institute, UCLA; 2009.

27. Gates GJ. Same-sex couples and the gay, lesbian, bisexual population: new estimates from the American Community Survey. Los Angeles, CA: The Williams Institute, UCLA; 2006.

28. Human Rights Campaign. Resources: Maps of State Laws and Policies. http://www.hrc.org/resources/entry/maps-of-state-laws-policies. Accessed March 31, 2012.

CHAPTER 3

Paper #1

Association of the Community Sex Ratio with HIV Status among Black Women Residing in High Risk Areas in the United States, 2006-07

Association of the Community Sex Ratio with HIV Status among Black Women Residing in High Risk Areas in the United States, 2006-07

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SYNOPSIS

Objective: The purpose of this analysis was to examine the association between the community sex ratio and HIV status among black women in high risk areas of 29 United States counties in 2006-07.

Methods: Six versions of the sex ratio – a global ratio covering all ages and races/ethnicities and five others stratified by age and race/ethnicity or both were calculated for the 29 counties using data derived from the American Community Survey 2005-09 five-year sample. Individual level HIV status and covariates were derived from CDC's National HIV Behavioral Surveillance System (NHBS-HET1) conducted in 2006-07. Multilevel logistic regression analyses were performed to assess the association between the county-level sex ratios and HIV status.

Results: No statistically significant relationships between the sex ratio and HIV status were found. For example, the odds ratio (OR) for the association between HIV status and the global sex ratio was 0.98 (95% CI: 0.94-1.01). The ORs and confidence intervals were similar for the other five sex ratios.

Conclusions: Our study found no significant association between any of six age- and/or race-specific sex ratios and HIV status among black women living high risk areas in 29 counties in the United States. This is contrary to the theoretically grounded hypothesis

that such a relationship would exist. The lack of relationship may be an artifact of certain limitations specific to this study.

INTRODUCTION

In 2008, the rate of new Human Immunodeficiency Virus (HIV) diagnoses among adults and adolescents in the United States (US) was nine times greater among blacks (73.7 diagnoses per 100,000) than among whites (8.2 per 100,000) (1). In a study of HIV prevalence conducted in 2006-07 in urban areas of 24 Metropolitan Statistical Areas (MSAs) with high Acquired Immune Deficiency Syndrome (AIDS) prevalence, the HIV prevalence ratio of whites relative to blacks was 0.6 (CI: 0.32−1.17) (2).

The black-white disparity is particularly stark among women. Despite accounting for less than 14.0% of the US female population in 2008 (3), blacks accounted for 66.7% of new HIV diagnoses among women in 2008 (1). On the other hand, whites accounted for 80.2% of the US female population but only for 18.0% of the new HIV diagnoses among women (1). Of women who contracted HIV through heterosexual contact living in 2007, 63.5% were black and 18.6% white, a prevalence ratio of 3.4 (1).

Despite previous research showing that the HIV disparity between black and white women is not driven solely by differences in individual level risk behaviors (4-9), most quantitative research into these disparities has to date focused on individual level factors such as race/ethnicity, income, education level, and housing status. Nevertheless, several studies have hypothesized a link between certain community level factors and the occurrence of HIV among black women (8, 10-27). One such community level factor is the sex ratio, which is defined as the ratio of men to women in a given geographic area (17).

Institutionalized racism, residential segregation, and other forms of black community dislocation such as imprisonment, unemployment, and higher rates of mortality have rearranged the normal patterns of dating as well as marriage and family dynamics in black communities (8, 11, 16, 17, 28, 29). An imbalanced sex ratio might lead some women to partner sexually with men whom they would not consider if the sex ratio were more balanced (16, 17, 30). It might also result in increased partner concurrency, specifically with individual men having larger numbers of female partners and reduce the power of women to negotiate condom use (16, 17, 30). Although several authors have hypothesized a link between the sex ratio and sexual risk behaviors (8, 16, 17, 25, 30-34) and some prior studies have linked the male-to-female sex ratio to rates of sexually transmitted diseases (STDs) (30, 35-37), no studies have assessed the link between an imbalanced sex ratio and the prevalence of HIV at the individual level. The purpose of this study was to examine the association between the community sex ratio and HIV status among black women living in high risk areas in 29 US counties in 2006-07.

METHODS

We developed multilevel models to evaluate the association between HIV status and six versions of the sex ratio among black female respondents to the pilot cycle of the National HIV Behavioral Surveillance System among heterosexuals at increased risk (NHBS-HET1) conducted in 2006-07. NHBS is a surveillance system implemented to monitor risk behaviors and HIV testing among persons at high risk HIV infection, including men who have sex with men (MSM), injecting drug users (IDU), and heterosexuals (HET). NHBS-HET1 was conducted in 25 MSAs and Metropolitan Divisions that, together, represent 66% of urban AIDS prevalence in the US (38). For NHBS-HET1, data were collected in areas where the population was at high risk for HIV. High risk areas (HRAs) were defined as census tracts that had high rates of HIV and AIDS diagnoses attributed to heterosexual contact and high rates of poverty. Typically, less than 20% of census tracts within MSAs were classified as HRAs. Project activities were conducted within HRAs and participants were eligible for the study if they resided in or had a social connection to a HRA. NHBS-HET1 and its sampling methods are described in greater detail elsewhere (39).

Because the majority of black female NHBS-HET1 respondents resided in the core urban areas of the sampled areas, analyses were limited to those counties with 10% or greater of the relevant Metropolitan Statistical Area (MSA) or Metropolitan Division’s black female NHBS-HET1 respondents or counties that were geographically contiguous to more than one county with 10% or more of black female NHBS-HET1 respondents (i.e., Queens

County (NY)). Because of Census sampling methods in New England, NHBS-HET1 survey sampling was based on towns rather than counties. For analytic purposes, relevant towns from the Boston New England City and Town Area (NECTA) were considered equivalent to counties. Using data from the 2005-09 five-year sample of the American Community Survey (ACS), six distinct sex ratios were calculated for 29 counties included in the NHBS-HET1 sampling frame.

Outcome of Interest: HIV Status

The outcome of interest was HIV status at the time a participant was interviewed as part of NHBS-HET1. HIV status was based on a combination of self-reported status and the results of HIV tests administered during the NHBS-HET1 survey. Preference was given to test results. That is, if a self-reported HIV status and an HIV test result were available for a respondent and not in agreement, the test result was used.

Exposures of Interest: Sex Ratios

Six different ratios were considered for the current analyses. First, a global sex ratio measure was created that included males and females of all races and ethnicities was calculated for people of all ages. Next, additional age-specific sex ratios were calculated (i.e., 18 years and older, 18 to 44 years). Third, race-specific sex ratios accounting only for black men and women were calculated for the same age groups (0+ years, 18+ years, and 18-44 years). Each of the six ratios was calculated for each census tract containing at least one black female NHBS-HET1 respondent. A single mean ratio, weighted by the number of respondents in each tract, was then calculated for each county of interest. Census tract level data were derived from the ACS 2005-09 five-year sample (40).

Potential Individual Level Effect Modifiers and Confounders

Data on all individual level variables were derived from NHBS-HET1. To the extent possible, individual level variables were coded so that higher numbers were associated with the theorized higher probability of positive HIV status. Age was considered as an ordinal variable. Annual household income was stratified into four groups based on its distribution in the sample population. Educational attainment was categorized as none to grade 11; grade 12 or GED; and some college or more. Employment status was categorized as disabled for work; unemployed; retired or other; and employed full- or part-time, homemaker, or full-time student. Housing status was considered as currently homeless; homeless at some point past 12 months but currently housed; not homeless at any point past 12 months. Whether or not a woman's last male sex partner had ever spent 24 hours or more in jail or prison was also included.

Analyses

Because there were multilevel aspects of the combined dataset and potential clustering within counties (i.e., observations from each county presumed to be correlated), hierarchical models were developed to assess the relationship between HIV status at the individual level and each of the six sex ratios while controlling for potential individual level modifiers and confounders. Descriptive statistics and model analyses were performed using SAS® version 9.2. Models were in the logistic form. The SAS® GLIMMIX procedure was used to account for random effects resulting from the nesting of the multiple levels. Because the data were cross-sectional, we chose to fit all models with an exchangeable correlation structure. Collinearity was evaluated using condition indices (cut point = 30) and variance decomposition proportions (cut point = 0.50) (41). Interaction was then assessed using the variables remaining after the previously described assessments (41).

Next, a series of models including all possible combinations of covariates (i.e., all variables other than the sex ratio of interest) were run for the six sex ratios of interest. Models were initially run with a random intercept but without any random slopes. Odds ratios (ORs) for the sex ratio of interest calculated and compared for the "full" model (i.e., exposure of interest and all variables included), "reduced" model (i.e., only the exposure of interest included), and other models including the sex ratio and all possible combinations of covariates. In addition the confidence intervals (CIs) calculated at $\alpha=0.05$ were compared across the full, reduced, and intervening models.

Certain models were given further consideration by introducing random slopes. The inclusion of a random intercept or random slope in a multilevel model indicates which effects should be considered while accounting for variability across clusters. All models were run with a random intercept. In addition, for the three overall sex ratio models, we introduced a random slope for housing status. For the black race-specific sex ratio models, we considered a random slope for housing status. We explored these particular random slopes because the relationship between HIV status and employment status was most likely to vary across counties for those of all race and ethnicities and the relationship between HIV and housing status was most likely to vary across counties for blacks.

RESULTS

Descriptive Statistics

The mean overall sex ratios for the three age groups (0 years and older; 18 years and older; and 18 to 44 years) were 93.0, 88.2 and 96.3, respectively (Table 1). The mean black race-specific sex ratios for the same age groups were 93.8, 87.0, and 92.4, respectively. For example, for every 100 women of all races and ethnicities ages 18 years and older in the 29 counties studied, there are 88.2 men of all races and ethnicities ages 18 years and older. For every 100 black women ages 18 years and older in the 29 counties, there are 87.0 black men. Although the mean overall sex ratio for all ages was slightly lower than the black race-specific ratio for all ages, it is likely driven by large black race-specific ratios in certain areas. In fact, the black-race specific ratio is greater than the overall ratio for all ages in only eight of the 29 counties studied. Looking at the median sex ratios, the overall sex ratios for the three age groups are closer to balanced (100) than the black race-specific for the same age groups.

The total NHBS-HET1 sample size for the study was 6,806 women living in high risk areas nested within 29 counties. Table 2 presents the relevant NHBS-HET1 sample characteristics. HIV prevalence in the sample was 3.0%. HIV test results rather than self-reported status were used for 97.7% of the sample. Significant differences ($p<0.05$) in HIV status were noted for age, annual income, educational attainment, and housing status. Last partner's incarceration history was not significantly associated with HIV status ($p=0.77$).

Table 3 presents HIV prevalence for four levels of each of the sex ratios – (1) below the 25th percentile; (2) 25th percentile to less than the median; (3) median to the 75th percentile; and (4) above the 75th percentile. For each of the sex ratios, HIV prevalence was highest among those areas below the 25th percentile (i.e., those areas with the fewest men relative to women). However, despite the trend's statistical significance, as the ratio of men to women increased, there was no apparent association with HIV prevalence for any of the six sex ratios. Figure 1 and 2 also show no apparent association between HIV status and the overall and black race-specific sex ratios for people 18 years and older.

Model Development

For each of the models, employment status and partner incarceration history were considered in potential interaction terms with the sex ratio of interest. Based on the collinearity assessment, both interaction terms were dropped from five of the six models. For the black race-specific sex ratio including (0+ years) only, the employment status interaction term remained. Interaction was evaluated only for the black race-specific sex ratio (0+ years). The remaining interaction term (employment status) was not significant and was thus dropped from this model.

The inclusion of a random slope for employment status, where applicable, was statistically significant for the three sets of affected models (global sex ratio, 18+ years, 18-44 years) but did not appreciably alter the corresponding ORs and CIs. Nevertheless, the random slope was retained in the full models but was not retained in the final models as these did not contain employment status as a covariate. The random slope for housing status introduced into the three sets of models for the black race-specific sex ratios (0+ years, 18+ years, and 18-44 years) did not substantially alter the results and were not statistically significant. Therefore, random slopes were not included in any of the full, final, or reduced models for black race-specific sex ratios.

The final model for the global sex ratio contained the sex ratio, age, and annual income. The final models for the 18+ years and 18-44 years overall sex ratios included the relevant sex ratio plus annual income and housing status. The OR for all three final models was 0.98 (95% CI: 0.94-1.01) (Table 4). While an OR below 1.0 fits with the hypothesis of fewer men relative to women in an area being related to positive HIV status, none of the ORs was statistically significant. This trend of near null values with borderline statistical significance was maintained across the full and reduced models. For the full and reduced global sex ratio models, the ORs for the sex ratio were 0.98 (95% CI: 0.95-1.02) and 0.98 (95% CI: 0.94-1.02). The full and reduced models for the 18+ years sex ratio were 0.98 (95% CI: 0.96-1.01) and 0.98 (95% CI: 0.94-1.01), respectively. While the full model OR for the 18-44 years sex ratio was 0.99 (95% CI: 0.96-1.01), the reduced model OR was 0.97 (95% CI: 0.94-1.01).

The trend of near null values with borderline statistical significance continued when we explored the black race-specific sex ratios (Table 5). For the final models for the black race-specific sex ratios for 0+, 18+, and 18-44 years, the ORs were 0.99 (95% CI: 0.98-

1.00), 0.99 (95% CI: 0.98-1.00), 0.99 (95% CI: 0.97-1.00), respectively. The ORs for the full and reduced models for all three black race-specific sex ratios were similar (data not shown).

All full, final, and reduced models were also run using the SAS® GENMOD procedure, which allows the researcher to fit generalized quasi-likelihood models. Results were similar to those obtained using the SAS® GLIMMIX procedure.

DISCUSSION

Our study showed that there was no association between the sex ratio and HIV status among black women living in high risk areas of 29 counties in the US. This trend of near null values with borderline statistical significance was maintained across all models – full, final, and reduced models with and without random slopes for (1) global sex ratio; (2) 18+ years overall sex ratio; (3) 18-44 years overall sex ratio; (4) 0+ years black race-specific sex ratio; (5) 18+ years black race-specific sex ratio; and (6) 18-44 years black race-specific sex ratio. These results indicate that the lack of association between the sex ratio and HIV status is likely impervious to the use of different age groups and racial/ethnic categories as well as the introduction or removal of certain covariates and random slopes for certain covariates.

Prior research into the association between the sex ratio and the presence of multiple sexual partners (17, 30) signaled that there might be a relationship between the sex ratio and HIV status for at least certain segments of the population. Specifically, an imbalanced sex ratio in a community in which there are fewer men than women might motivate some women to choose male sexual partners they might not have considered if the balance between men and women in their community were more even and also result in greater partner concurrency (16, 17, 30). Building on the prior research, we explored sex ratios for different age and racial groups to examine the hypothesis that different sexual partnering patterns related to age and race might affect the relationship between the sex ratio and HIV status. This hypothesis was not supported in our results.

Nevertheless, racial disparities in the prevalence of HIV persist. To date, most research into these disparities has focused on individual level factors. Although there has been an increased theoretical focus on the impact of certain community level factors on disparities in HIV prevalence, there remain some difficulties in identifying and measuring relevant community level variables for inclusion in epidemiologic analysis. Despite our study's failure to find any significant associations between the sex ratio and HIV status, measurement of the association between different versions of the sex ratio and HIV status is an important step toward determining which societal and structural level variables are linked with occurrence of the disease. In addition, the absence of a significant association may be an artifact of the specific high-risk areas in which NHBS was conducted or the fact that we explored HIV prevalence rather than incidence. Given this as well as the previously established connection between the sex ratio and sexual partnering patterns (17, 30), further research into the association between HIV incidence and prevalence and the sex ratio and other extra-individual variables may be warranted.

Study Strengths

This study has three main strengths. First, it incorporated 6,806 black women who reside in 29 counties across 17 states. Next, we examined a number of age- and race-specific sex ratios to assess how the relationship between the sex ratio and HIV prevalence may change based on sex ratios among different subpopulations. Finally, this is the first study of which we aware that uses multilevel modeling techniques to examine the potential association between the sex ratio and HIV status at the individual level.

Study Limitations

Our study was subject to a number of limitations. First is the relatively homogenous nature of the high risk areas – predominantly city cores – in which NHBS-HET1 was conducted. As such, any relationships demonstrated in this study are relevant only in certain, limited geo-economic settings. The relationship between the sex ratio and HIV status is possibly quite different outside the high risk areas.

Second, the sex ratios were not adjusted for the presence of men who have sex with men (MSM) and women who have sex with women (WSW) who are not interested in engaging in sexual relationships with partners of a different sex. Because of the lack of population data on these men and women at the census tract or even the county level, we cannot know in which way, if at all, accounting for their presence in the population might alter the sex ratios for any or all of the counties of interest.

Third is the relatively small number of counties. Having only 29 counties in the analyses required that we limit the number of county-level exposures in the models. Therefore, we could not control for other potentially relevant community level phenomena such as residential segregation. The number of random slopes that could be included in any one model version had to remain small. To address this, we chose one random slope for the three overall sex ratio models (employment status) and another for the three black race-specific sex ratio models (housing status) and considered only those. Neither random slope substantially changed any of the model results

In addition, we did not control for the different stage of the HIV epidemic across the 29 counties studied. The spatial distribution of new HIV diagnoses today is different today from when the epidemic was in its nascent stages. HIV prevalence may be higher relative to incidence in areas with a more “mature” HIV epidemic. Therefore, any future studies accounting for area-level effects on HIV prevalence and incidence should take into account for the stage of the epidemic in each areas, perhaps by including a variable such as years since first confirmed HIV diagnosis in model analyses.

Finally, the outcome was relatively rare even in the high risk areas. This rather low prevalence may mean that significant effects may be detectable only with tremendously large imbalances in the sex ratio. Sex ratios this imbalanced may not exist in the US outside of correctional facilities. If we had modeled sexual risk behaviors or the incidence of sexually transmitted diseases, it is likely that we would have seen a stronger, positive association with the sex ratio.

CONCLUSIONS

Our study found no significant association between any of six age- and/or race-specific sex ratios and HIV status among black women living in 29 counties in the US. This is contrary to the theoretically grounded hypothesis that such a relationship would exist. There may be no relationship between the sex ratio and HIV status. If this is the case, further research can concentrate on other area level factors such as residential segregation that might be related to HIV status. Alternatively, the lack of relationship may be an artifact of certain limitations specific to this study. Such limitations include the relative homogeneity of the high risk areas sampled for NHBS-HET1 and the inability to control for multiple county level factors or to consider simultaneous random slopes in the modeling analyses. Considering these limitations and the previously established connection between the sex ratio and sexual partnering patterns (17, 30), further research into the roles the sex ratio and other extra-individual factors play in the occurrence of HIV may be warranted.

REFERENCES

1. Centers for Disease Control and Prevention. HIV Surveillance Report, 2008. http://www.cdc.gov/hiv/topics/surveillance/resources/reports/. Accessed March 31, 2012.
2. Centers for Disease Control and Prevention. Characteristics associated with HIV infection among heterosexuals in urban areas with high AIDS prevalence - 24 cities, United States, 2006-2007. MMWR. 2011;60(31):1045-9.
3. Bureau of the Census. Statistical Abstract of the United States. http://www.census.gov/compendia/statab/cats/population.html. Accessed March 31, 2012.
4. Leichliter JS, Aral SO. Black women in the United States decrease their number of recent sex partners: temporal trends from the national survey of family growth. Sex Transm Dis. 2009;36(1):1-3.
5. Leichliter JS, Chesson HW, Sternberg M, Aral SO. The concentration of sexual behaviours in the USA: a closer examination of subpopulations. Sex Transm Infect. 2010;86 Suppl 3:45-51.
6. Hallfors DD, Iritani BJ, Miller WC, Bauer DJ. Sexual and drug behavior patterns and HIV and STD racial disparities: the need for new directions. Am J Public Health. 2007;97(1):125-32.
7. Wyatt GE, Myers HF, Williams JK, Kitchen CR, Loeb T, Carmona JV, et al. Does a history of trauma contribute to HIV risk for women of color? Implications for prevention and policy. Am J Public Health. 2002;92(4):660-5.

8. Lane SD, Rubinstein RA, Keefe RH, Webster N, Cibula DA, Rosenthal A, et al. Structural violence and racial disparity in HIV transmission. J Health Care Poor Underserved. 2004;15(3):319-335.

9. Tillerson K. Explaining racial disparities in HIV/AIDS incidence among women in the U.S.: a systematic review. Stat Med. 2008;27(20):4132-43.

10. Zierler S, Krieger N. Reframing women's risk: Social inequalities and HIV infection. Annu Rev Public Health. 1997;18:401-436.

11. Adimora AA, Schoenbach VJ. Social context, sexual networks, and racial disparities in rates of sexually transmitted infections. J Infect Dis. 2005;191 Suppl 1:S115-22.

12. Adimora AA, Schoenbach VJ, Doherty IA. HIV and African Americans in the southern United States: sexual networks and social context. Sex Transm Dis. 2006;33(7 Suppl):S39-45.

13. Adimora AA, Schoenbach VJ, Floris-Moore MA. Ending the epidemic of heterosexual HIV transmission among African Americans. Am J Prev Med. 2009;37(5):468-71.

14. Aral SO, Adimora AA, Fenton KA. Understanding and responding to disparities in HIV and other sexually transmitted infections in African Americans. Lancet. 2008;372(9635):337-40.

15. Harawa N, Adimora A. Incarceration, African Americans and HIV: advancing a research agenda. J Natl Med Assoc. 2008;100(1):57-62.

16. Lemelle AJ, Jr. Racialized social system and HIV infection: the case of African Americans. International Journal of Sociology and Social Policy. 2002;22(4-6):133-158.

17. Pouget ER, Kershaw TS, Niccolai LM, Ickovics JR, Blankenship KM. Associations of sex ratios and male incarceration rates with multiple opposite-sex partners: potential social determinants of HIV/STI transmission. Public Health Rep. 2010;125 Suppl 4:70-80.

18. Sanders-Phillips K. Factors influencing HIV/AIDS in women of color. Public Health Rep. 2002;117(3):S151-S156.

19. El-Sadr WM, Mayer KH, Hodder SL. AIDS in America--forgotten but not gone. N Engl J Med. 2010;362(11):967-70.

20. Cargill VA, Stone VE. HIV/AIDS: a minority health issue. Med Clin North Am. 2005;89(4):895-912.

21. Doherty IA, Leone PA, Aral SO. Social determinants of HIV infection in the Deep South. Am J Public Health. 2007;97(3):391.

22. Cooper HL, Friedman SR, Tempalski B, Friedman R. Residential segregation and injection drug use prevalence among Black adults in US metropolitan areas. Am J Public Health. 2007;97(2):344-52.

23. Thomas JC, Levandowski BA, Isler MR, Torrone E, Wilson G. Incarceration and sexually transmitted infections: A neighborhood perspective. J Urban Health. 2008;85(1):90-99.

24. Friedman SR, Cooper HLF, Osborne AH. Structural and social contexts of HIV risk among African Americans. Am J Public Health. 2009;99(6):1002-1008.

25. Adimora AA, Auerbach JD. Structural interventions for HIV prevention in the United States. J Acquir Immune Defic Syndr. 2010;55 Suppl 2:S132-5.

26. Higgins JA, Hoffman S, Dworkin SL. Rethinking gender, heterosexual men, and women's vulnerability to HIV/AIDS. Am J Public Health. 2010;100(3):435-45.

27. Ickovics J, Beren S, Grigorenko E, Morrill A, Druley J, Rodin J. Pathways of risk: race, social class, stress, and coping as factors predicting heterosexual risk behaviors for HIV among women. AIDS Behav. 2002;6:339-50.

28. Doyle R. Fewer men, more crime. Sci Am. 2005;293(5):32.

29. Adimora AA, Schoenbach VJ. Contextual factors and the black-white disparity in heterosexual HIV transmission. Epidemiology. 2002;13(6):707-712.

30. Senn TE, Carey MP, Vanable PA, Urban MA, Sliwinski MJ. The male-to-female ratio and multiple sexual partners: multilevel analysis with patients from an STD clinic. AIDS Behav. 2008;14(4):942-8.

31. Bontempi JM, Eng E, Quinn SC. Our men are grinding out: a qualitative examination of sex ratio imbalances, relationship power, and low-income African American women's health. Women Health. 2008;48(1):63-81.

32. Logan TK, Cole J, Leukefeld C. Women, sex, and HIV: social and contextual factors, meta-analysis of published interventions, and implications for practice and research. Psychol Bull. 2002;128(6):851-85.

33. Gouveia-Oliveira R, Pedersen AG. Higher variability in the number of sexual partners in males can contribute to a higher prevalence of sexually transmitted diseases in females. J Theor Biol. 2009;261(1):100-6.

34. Harris G, Mallory C, Stampley C. A qualitative study of man-sharing and the implications for midlife African American women's risk for HIV infection. Women Health. 2010;50(7):670-87.

35. Thomas JC, Sampson LA. High rates of incarceration as a social force associated with community rates of sexually transmitted infection. J Infect Dis. 2005;191 Suppl 1:S55-60.

36. Thomas JC, Gaffield ME. Social structure, race, and gonorrhea rates in the southeastern United States. Ethn Dis. 2003;13(3):362-8.

37. Kilmarx PH, Zaidi AA, Thomas JC, Nakashima AK, St Louis ME, Flock ML, et al. Sociodemographic factors and the variation in syphilis rates among US counties, 1984 through 1993: an ecological analysis. Am J Public Health. 1997;87(12):1937-43.

38. Centers for Disease Control and Prevention. National HIV Behavioral Surveillance among Heterosexuals at Risk of HIV Infection (NHBS-HET): Model Surveillance Protocol: NCHHSTP/DHAP/BCSB/Behavioral Surveillance Team; 2006.

39. Gallagher KM, Sullivan PS, Lansky A, Onorato IM. Behavioral surveillance among people at risk for HIV infection in the U.S.: the National HIV Behavioral Surveillance System. Public Health Rep. 2007;122 Suppl 1:32-8.

40. Bureau of the Census. An Overview of the American Community Survey. http://www.census.gov/acs/www/guidance_for_data_users/training_presentations/. Accessed March 31, 2012.

41. Kleinbaum DG, Klein M. Logistic Regression: A Self-Learning Text. Third ed. New York: Springer; 2010.

TABLES AND FIGURES

Table 1. Mean Overall Age- and Race-Specific Sex Ratios for 29 United States Counties, 2005-09

County	State	Overall Sex Ratio, 0+ Years	Black Race-Specific Sex Ratio, 0+ Years	Overall Sex Ratio, 18+ Years	Black Race-Specific Sex Ratio, 18+ Years	Overall Sex Ratio, 18-44 Years	Black Race-Specific Sex Ratio, 18-44 Years
Los Angeles County	CA	96.0	86.9	91.5	80.4	100.7	91.5
San Diego County	CA	123.9	198.4	120.8	199.3	118.1	213.5
San Francisco County	CA	104.2	96.4	102.3	88.6	114.9	102.9
Denver County	CO	104.4	109.8	102.6	111.0	108.8	107.9
Fairfield County	CT	93.4	94.8	85.7	81.6	93.5	92.0
New Haven County	CT	94.5	90.7	91.7	85.8	104.1	96.5
District of Columbia	DC	83.7	83.7	80.0	79.0	83.1	85.5
Broward County	FL	98.5	95.6	91.4	87.9	91.8	90.6
Miami-Dade County	FL	84.8	83.0	74.7	68.5	80.0	71.0
Fulton County	GA	89.7	84.5	85.7	78.5	93.8	85.5
Cook County	IL	90.3	88.8	80.6	77.2	96.5	97.7
Orleans Parish	LA	89.9	85.5	87.1	81.4	102.8	88.1
Dorchester (town)	MA	86.0	82.7	80.7	74.4	89.7	84.3
Lawrence (town)	MA	94.0	89.8	92.7	87.6	92.1	47.5
Roxbury (town)	MA	89.6	87.3	85.1	81.5	95.4	91.1

Baltimore City	MD	90.0	90.4	84.6	81.9	90.7	86.7
Wayne County	MI	86.4	88.7	81.4	82.8	93.2	95.8
St. Louis City	MO	86.5	82.6	78.6	72.7	87.3	81.8
Essex County	NJ	86.1	91.7	77.5	75.0	87.6	85.0
Nassau County	NY	97.0	84.4	91.3	72.4	104.1	79.9
Suffolk County	NY	93.8	87.8	91.9	86.9	94.3	82.0
Bronx County	NY	83.9	95.8	81.1	89.8	78.2	85.5
Kings County	NY	82.2	78.7	75.1	70.9	80.8	79.4
New York County	NY	86.0	81.9	79.8	74.2	90.2	90.6
Queens County	NY	98.2	86.1	95.7	79.9	112.8	85.8
Philadelphia County	PA	86.8	74.7	79.9	68.4	93.2	77.0
Dallas County	TX	98.7	88.4	92.9	80.3	102.3	88.7
Harris County	TX	98.6	90.3	96.2	85.5	109.3	93.6
King County	WA	100.9	142.1	98.2	139.0	102.9	122.0
mean		**93.0**	**93.8**	**88.2**	**87.0**	**96.3**	**92.4**
median		**90.3**	**88.4**	**85.7**	**81.4**	**93.8**	**88.1**

Table 2. Sample Characteristics, Black Female NHBS-HET1 (2006-07) Respondents in 29 Counties (N=6,806)

	HIV+	HIV-	*p-value**
Age			
45 to 50 years	4.4%	95.6%	**<0.05**
40 to 44 years	6.3%	93.7%	
35 to 39 years	5.1%	94.9%	
30 to 34 years	2.7%	97.3%	
25 to 29 years	1.1%	98.9%	
18 to 24 years	0.4%	99.6%	
Annual Income			
$0 to $4,999	3.6%	96.5%	**<0.05**
$5,000 to $9,999	4.3%	95.7%	
$10,000 to $29,999	1.7%	98.3%	
$30,000 or more	1.8%	98.2%	
Education			
none to grade 11	4.1%	95.9%	**<0.05**
grade 12 or GED	2.7%	97.3%	
some college or more	2.0%	98.0%	
Employment Status			
disabled for work	10.3%	89.7%	**<0.05**
unemployed	3.6%	96.4%	
retired or other	1.6%	98.4%	
employed full- or part-time, homemaker, or full-time student	1.4%	98.6%	
Housing Status			
currently homeless	5.8%	94.2%	**<0.05**
homeless at some point past 12 months but currently housed	3.7%	96.3%	
not homeless at any point past 12 months	2.5%	97.5%	
Last Male Partner Spent ≥24 Hours in Jail/Prison			
yes	3.0%	97.0%	**0.77**
no	2.8%	97.2%	

*Chi-square test for trend (α=0.05)

Table 3. HIV Status by Level of Age- and Race-Specific Community Sex Ratios, NHBS-HET1 (2006-07) Respondents in 29 Counties (N=6,806)

	N	HIV+	HIV-	*p-value*
sex ratio, 0+ years				
below 25th percentile	1,394	6.0%	94.1%	**<0.05**
25th percentile to less than median	1,966	1.7%	98.3%	
median to 75th percentile	1,573	3.8%	96.3%	
above 75th percentile	1,873	1.5%	98.5%	
black race-specific sex ratio, 0+ years				
below 25th percentile	1,648	4.3%	95.8%	**<0.05**
25th percentile to less than median	2,152	1.8%	98.2%	
median to 75th percentile	1,370	1.8%	98.3%	
above 75th percentile	1,636	4.3%	95.7%	
sex ratio, 18+ years				
below 25th percentile	1,934	4.5%	95.5%	**<0.05**
25th percentile to less than median	1,855	2.1%	97.9%	
median to 75th percentile	1,140	4.2%	95.8%	
above 75th percentile	1,877	1.6%	98.5%	
black race-specific sex ratio, 18+ years				
below 25th percentile	1,743	4.8%	95.2%	**<0.05**
25th percentile to less than median	1,702	1.8%	98.2%	
median to 75th percentile	2,171	1.9%	98.1%	
above 75th percentile	1,190	3.9%	96.1%	
sex ratio, 18-44 years				
below 25th percentile	1,686	4.8%	95.2%	**<0.05**
25th percentile to less than median	1,958	2.6%	97.4%	
median to 75th percentile	1,490	1.3%	98.7%	
above 75th percentile	1,672	3.1%	97.0%	
black race-specific sex ratio, 18-44 years				
below 25th percentile	1,732	4.8%	95.2%	**<0.05**
25th percentile to less than median	1,383	2.9%	97.1%	
median to 75th percentile	1,478	2.2%	97.8%	
above 75th percentile	2,213	2.2%	97.8%	

Table 4. Multilevel Logistic Regression Results: Full, Reduced, and Final Models for Association of Overall Sex Ratio and HIV Status among Black Women in 29 United States Counties

	Model A* (final)		**Model B** (final)**		**Model C*** (final)**	
exposure/covariates	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
overall sex ratio	0.98	(0.94-1.01)	0.98	(0.94-1.01)	0.98	(0.94-1.01)
age	1.44	(1.29-1.60)	-	-	-	-
annual income	1.27	(1.11-1.45)	1.22	(1.06-1.40)	1.22	(1.06-1.40)
housing	-	-	1.33	(0.94-1.86)	1.32	(0.94-1.86)

*Model A contains sex ratio for all ages as the exposure and other model covariates as indicated.

**Model B contains sex ratio for 18 years and older as the exposure and other model covariates as indicated.

***Model C contains sex ratio for 18-44 years as the exposure and other model covariates as indicated.

OR=odds ratio; CI=confidence interval

Table 5. Multilevel Logistic Regression Results: Full, Reduced, and Final Models for Association of Black Race-Specific Sex Ratio and HIV Status among Black Women in 29 United States Counties

	Model D* (final)		Model E** (final)		Model F*** (final)	
exposure/covariates	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
black race-specific sex ratio	0.99	(0.98-1.00)	0.99	(0.98-1.00)	0.99	(0.97-1.00)
age	-	-	-	-	1.46	(1.31-1.63)
employment	-	-	1.80	(1.49-2.19)	-	-
housing	1.44	(1.06-1.96)	1.24	(0.94-1.65)	-	-
partner incarceration	-	-	-	-	1.15	(0.84-1.58)

*Model D contains black race-specific sex ratio for all ages as the exposure and other model covariates as indicated.

**Model E contains black race-specific sex ratio for 18 years and older as the exposure and other model covariates as indicated.

***Model F contains black race-specific sex ratio for 18-44 years as the exposure and other model covariates as indicated.

OR=odds ratio; CI=confidence interval

Figure 1. HIV Prevalence by Overall Sex Ratios (18+ Years) among Black Women, 29 United States Counties

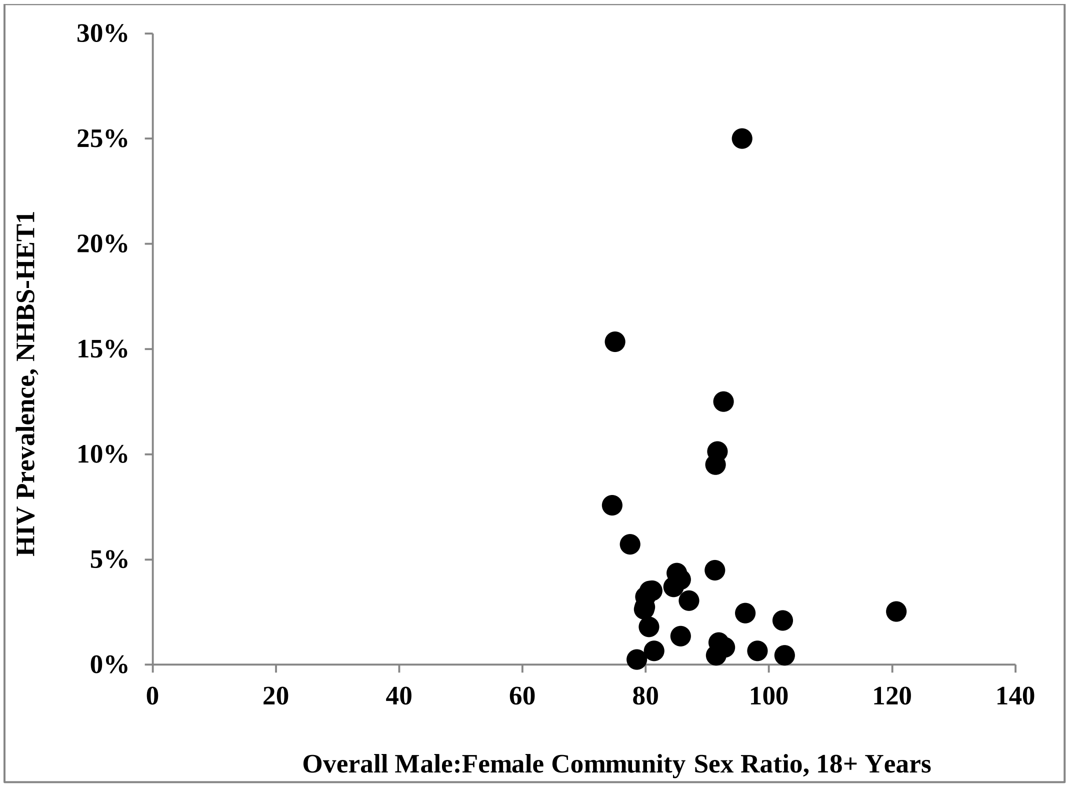
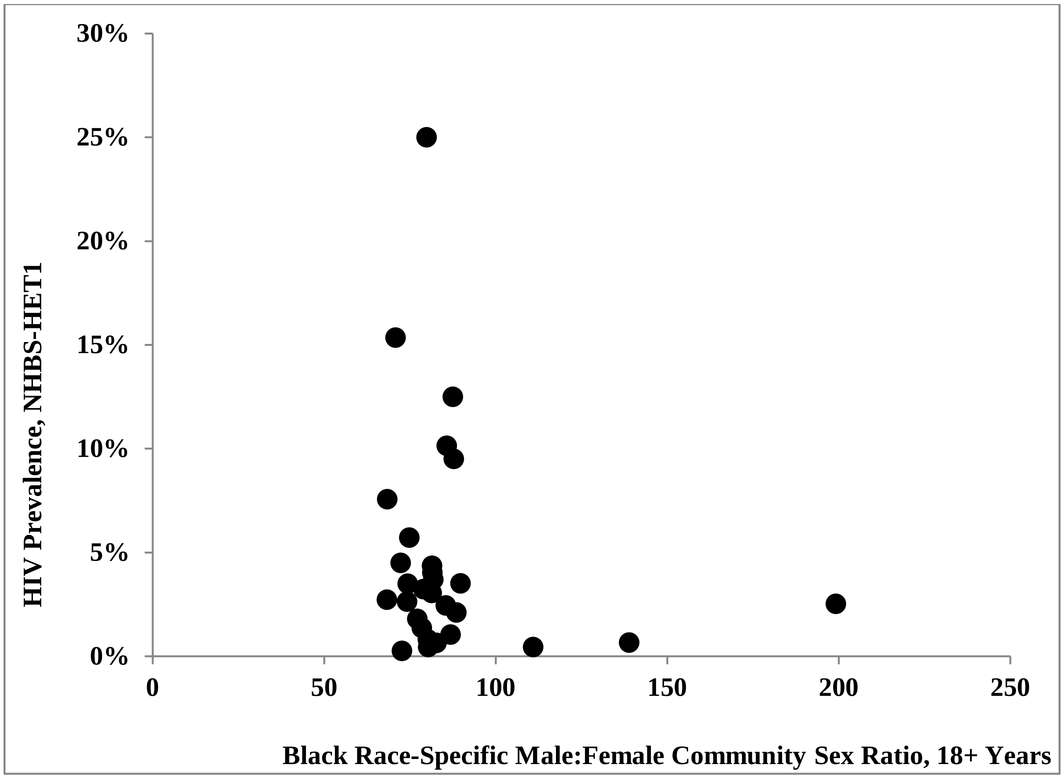


Figure 2. HIV Prevalence by Overall Sex Ratios (18+ Years) among Black Women, 29 United States Counties



CHAPTER 4

Paper #2

Association of Perceived Discrimination against Gay and Bisexual Men with HIV Status among Men who Have Sex with Men in the United States

Association of Perceived Discrimination against Gay and Bisexual Men with HIV Status among Men who Have Sex with Men in the United States

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SYNOPSIS

Objective: The purpose of this study was to assess the association between perceived interpersonal discrimination against gay and bisexual men within the communities where they live and HIV status at the individual level among men who have sex with men (MSM) in 18 United States (US) Metropolitan Statistical Areas.

Methods: Perceptions of discrimination were based on aggregated responses to an online survey. Individual level HIV status and covariates were derived from CDC's MSM National HIV Behavioral Surveillance System (NHBS-MSM2) conducted in 2008. Multilevel logistic regression models were run to assess the association between perceptions of interpersonal discrimination against gay and bisexual men and HIV status among MSM.

Results: Based on 1,628 useable surveys from respondents in 18 MSAs, perceptions of discrimination were highest in Detroit and lowest in San Francisco. No statistically significant associations between perceived discrimination against gay and bisexual men at the community level and HIV status among MSM were found.

Conclusions: We hypothesized that higher perceived discrimination against gay and bisexual men would lead to psychological distress among these men and thus precipitate participation in risky sexual activities. Nevertheless, our study found no significant association between community-based interpersonal discrimination and HIV status.

Considering the opposition of certain theoretical approaches to the proposed discrimination-HIV link as well as our study's limitations, further research measuring the relationship between perceptions of discrimination at the community level and HIV incidence and prevalence at the individual among different MSM populations across the US is needed.

INTRODUCTION

In the United States (US), men who have sex with men (MSM) are disproportionately affected by HIV. MSM are the only identified risk group in the US in which HIV incidence has continued to increase after 2000 (1). Of all new HIV diagnoses among men and women in the US, 55.6% in 2006, 57.7% in 2007, 56.3% in 2008, and 60.9% in 2009 were due to male-to-male sexual contact (2).

Several factors at different levels – individual, community, state – have been hypothesized as being linked with HIV among MSM. One of these factors is interpersonal discrimination against gay and bisexual men and the perception and internalization of such discrimination on the part of these men. In 2008, 72.3% of African American and 51.6% of white respondents to the General Social Survey indicated that homosexuality is "always wrong (3)." This suggests that, regardless of where they live, MSM are likely to face discrimination from the mainstream heterosexual community. The only differences are likely related to how they perceive this discrimination and the extent to which they internalize it.

Prior research has linked internalized homophobia with sexual risk behavior in MSM (4-10). Negative treatment from society, including discrimination against MSM, has been shown to reduce self-acceptance and lead to abnormally high chronic stress, which has, in turn, been linked to participation in high-risk sexual behavior (11-17). Previous research has shown that perceptions of discrimination and other psychosocial factors affect the sex-seeking and sexual behaviors of MSM (4-8, 18-20). Specifically, stigmatized individuals who may be more prone to find themselves in difficult sexual situations are also less able to exert self-control and thus to avoid participating in risky sexual activities (15, 18, 21, 22). However, no studies have evaluated the association of prevalent HIV infection at the individual level among MSM with perceptions of discrimination among such men. The purpose of this study was to assess the association between perceived interpersonal discrimination against gay and bisexual within the communities where they live with HIV status at the individual level among MSM in 18 US Metropolitan Statistical Areas (MSAs) and Metropolitan (Metro) Divisions in 2008.

METHODS

We developed multilevel logistic regression models to assess the association between perceptions of discrimination against gay and bisexual men at the community level and HIV status at the individual level. HIV status and individual level covariates were taken from 18 of the 21 MSAs and Metro Divisions covered by the 2008 National HIV Behavioral Surveillance System (NHBS-MSM2) conducted among MSM by the Centers for Disease Control and Prevention (CDC). NHBS-MSM2 was conducted in MSAs and Metro Divisions that, together, represent 66% of urban AIDS prevalence in the US (23). NHBS-MSM2 respondents were limited to men ages 18 years of age and older living within the sampling frames of each MSA or Metro Division. HIV status and individual level covariates for this study were derived from NHBS-MSM2. NHBS methods have been described in greater detail elsewhere (24).

Perceptions of discrimination were based on a survey conducted among gay and bisexual in these 18 MSAs and Metro Divisions. All survey recruitment and administration were conducted exclusively online. Survey responses were collected from individuals and then aggregated to calculate average discrimination scores for each MSA and Metro Division.

Outcome of Interest: HIV Status

Initially measured at interview for NHBS-MSM2, HIV status for the current study was assessed using a combination of self-reported status and HIV test results. Preference was given to test results. In other words, if a self-reported status and a test result were available for a specific respondent and not in agreement, the test result was used.

Exposure of Interest: Perceived Discrimination against Gay and Bisexual Men

Although NHBS-MSM2 collected information on behavioral risk factors and HIV status among MSM throughout the US, it did not collect information on experienced or perceived discrimination. Therefore, we conducted a survey of perceived interpersonal discrimination among gay and bisexual men, responses to which were aggregated at the MSA or Metro Division level and then merged with the NHBS-MSM2 dataset to test the association between perceived discrimination among gay and bisexual men at MSA and Metro Division level with HIV status at the individual level.

The survey was conducted online. Six different banner advertisements (Figure 1) announcing the survey were displayed between November 2011 and January 2012 to Facebook users whose profiles indicated that they were 18 years or older, male, interested in men, and resided within a 50-mile radius of one of the main cities of 18 of the MSAs and Metro Divisions covered by NHBS-MSM2. Men clicking on the Facebook advertisements were taken to an eligibility screener where screened based on age (18 years or older); sex (male); sexual activity (at least one male sex partner past 12 months); and city of residence (main city of one of 18 MSAs or Metro Divisions of interest). Eligible respondents who consented to participate were administered the online survey.

The study protocol, including the survey and informed consent form, was reviewed and approved by the Emory University Institutional Review Board.

Respondents were asked 16 questions about perceptions of interpersonal discrimination in the city or town in which they live. These questions were initially developed for another study (25). These questions were answered on a five-point Likert scale ranging from “strongly disagree” to “strongly agree.” The questions were scored so that a higher number reflected higher perceived discrimination. Survey results were summed and an average score was then calculated for men in each MSA or Metro Division. Two average scores were calculated for each MSA or Metro Division – an “overall” score encompassing responses to all 16 questions and a “partial” score covering nine of the questions most directly related to perceived discrimination against gay and bisexual men.

Potential Individual Level Effect Modifiers and Confounders

Data on all individual level variables were derived from NHBS-MSM2. Variables were coded such that the highest numbers were associated with the hypothesized highest probability of positive HIV status. Age was considered as an ordinal variable. Race/ethnicity was categorized as non-Hispanic black; Hispanic; other; and non-Hispanic white. Annual household income was grouped into four strata based on distribution in the sample. Employment status was grouped into two categories based on the likelihood of being associated with HIV status. First were those who reported being unemployed, retired, disabled for work, or other. Second were those who reported being employed full-time or part-time, homemaker, or full-time student were combined in another. Although we recognize that substance misuse may lie in the causal pathway between perceptions of discrimination and HIV, non-injection drug use was included as a potential confounder. It was specified as used drugs or not in the past 12 months. Finally, outness was specified as a respondent's having told anyone or not that he is attracted to or has sex with men.

Analyses

Because there is clustering within MSAs or Metro Divisions, multilevel logistic regression models were developed to examine the association between HIV status at the individual level with perceived discrimination scores at the MSA or Metro Division level while accounting for potential individual level effect modifiers and confounders. Full and partial perceived discrimination scores were considered as single exposures in two distinct models. Descriptive statistics were calculated and analyses performed using SAS® version 9.2. The SAS® GLIMMIX procedure was used to account for random effects resulting from the nesting of the multiple levels. All models were fit with an exchangeable correlation structure because the data were-cross sectional. Collinearity was evaluated using condition indices (cut point = 30) and variance decomposition proportions (cut point = 0.50) (26). For both the overall and partial perceived discrimination models, interaction terms combining the measures of discrimination with one of four variables – race/ethnicity, annual income, employment status, and outness – were evaluated.

After collinearity assessment, odds ratios (ORs) for a one-unit change in the overall and partial perceived discrimination scores were calculated and reviewed for two series of models that included all possible combinations of covariates (i.e., all variables other than the perceived discrimination exposure of interest). Models were initially run using only a random intercept. Two tables of ORs were created – one for the overall perceived discrimination score and the second for the partial perceived discrimination score. These tables allowed for comparison of the "full" model (i.e., all variables included), "reduced" model (i.e., only the exposure of interest included), and models based on all possible combinations of covariates. Models were compared based on proximity of the perceived discrimination OR to that of the full model; precision as determined by the width of the corresponding 95% confidence interval (CI); and parsimony (i.e., number of variables in model).

Following these comparisons, certain models were considered further by evaluating the inclusion of a random slope. The inclusion of a random intercept or random slope in a multilevel model indicates which effects should be considered while accounting for variability across MSAs or Metro Divisions. Although all models included a random intercept, we did not include a random slope for the area level measures of overall or partial perceived discrimination. However, we did evaluate a random slope for race/ethnicity based on the hypothesis that the relationship between HIV status and race/ethnicity varies substantially across MSAs and Metro Divisions.

RESULTS

Descriptive Statistics

Over the course of the 66 days for which the survey site was open, the advertisements used for this study (Figure 1) garnered 10,356,873 impressions and 6,751 clicks. These clicks yielded 1,642 survey responses that were considered useable (i.e., sufficient number of discrimination-related questions answered). Among these responses, there were 33 sets of duplicate Internet Protocol (IP) addresses. Responses from duplicate IP addresses were removed from consideration if they matched earlier responses from the same IP address on answers to all four screener questions and at least one of the first four survey questions (zip code, race, Hispanic ethnicity, have a main male partner). This left a total survey sample size of 1,628 unique respondents. The mean overall and partial discrimination scores were 41.4 (SD=4.2, range: 33.2-48.5) and 22.3 (SD=3.1, range: 16.7-27.9), respectively (Table 1). San Francisco had the lowest overall and partial perceived discrimination scores and Detroit the highest.

The total sample size for the NHBS-MSM2 respondent dataset was 9,390. HIV status was based on test results rather than self-report for 89.2% of the NHBS-MSM2 sample. HIV prevalence in the NHBS-MSM2 sample was 19.2%. HIV prevalence increased with age through the age group 50-59 years and then decreased slightly (Table 2). HIV was significantly related to race/ethnicity ($p<0.05$). HIV status was also significantly inversely related to annual income ($p<0.05$). Those who were retired, unemployed, disabled for work, or other were significantly more likely to be HIV-positive than those who were employed full- or part-time or who identified themselves as a full-time student ($p<0.05$). Those who used non-injection drugs in the past 12 months were significantly more likely to be HIV-positive than those who did not ($p<0.05$). Finally, those respondents who had told nobody that they were attracted to or have sex with other men were significantly less likely to be HIV-positive than those men who had told anybody ($p<0.05$) (Table 2).

HIV prevalence was higher in areas where the overall perceived discrimination score and/or the partial perceived discrimination score were above the 75th percentile (Table 3). Although HIV prevalence decreased when moving from areas where overall perceived discrimination was above the 75th percentile to areas where it was between the median and 75th percentile, HIV prevalence then increased as perceived discrimination decreased. The overall trend was statistically significant ($p<0.05$). For partial perceived discrimination, there appears to be a dose-response trend ($p<0.05$) in that HIV prevalence decreased as perceived discrimination decreased. However, based on Figures 2 and 3, which present HIV prevalence by the overall and partial perceived discrimination scores, there is no apparent relationship between HIV prevalence and measures of perceived discrimination across the 18 MSAs and Metro Divisions.

Model Development

Based on collinearity assessment, all four interaction terms were dropped from both models. Since none of the interaction terms remained in either model, interaction was not assessed. Although the random slope for race/ethnicity was statistically significant ($p<0.05$) for both full models as well as the final model for overall perceived discrimination, its inclusion in the models did not appreciably change the OR for either the overall or the perceived partial discrimination scores. Nevertheless, given the statistical significance, the random slope for race/ethnicity was maintained in these three models. Full, final, and reduced models for the overall and partial perceived discrimination scores are presented in Tables 4-5.

The OR for overall perceived discrimination was 1.0 for the full, final, and reduced models with only very slight variations in the CI (95% CI: 0.96 to 1.03 for full model; 95% CI: 0.96 to 1.04 for final and reduced models). This indicates that there was no association between the measure of overall perceived discrimination against gay and bisexual men in an area and HIV status among MSM. The introduction of a random slope for race/ethnicity – based on the theory that the relationship between perceived discrimination and HIV status might change across MSAs or Metro Divisions depending on race/ethnicity – did not substantially alter the relationship. For the full and final models without such a random slope the ORs for the relationship between perceived discrimination and HIV status were 0.99 (95% CI: 0.96-1.02) and 0.99 (95% CI: 0.96-1.03), respectively.

The results for the partial perceived discrimination models were very similar. The ORs for the full, final, and reduced models were 1.00 (95% CI: 0.95-1.05), 1.00 (95% CI:

0.95-1.05), and 1.01 (95% CI: 0.96-1.07), respectively. These ORs show no association between perceptions of discrimination against gay and bisexual men at the MSA and Metro Division level and HIV status among MSM at the individual level. This lack of association was also apparent without a random slope for race/ethnicity in the full model (OR=0.99 (95% CI: 0.95-1.04)).

All full, final, and reduced models were also run using the SAS® GENMOD procedure. Results were similar to those obtained using the SAS® GLIMMIX procedure.

DISCUSSION

Based on prior research into the association between tolerance of gay and bisexual men and HIV rates among these men (27) as well research linking internalized homophobia with sexual risk behaviors (4-10), we hypothesized that there would be an association between perceived interpersonal discrimination against gay and bisexual men at the MSA or Metro Division level and HIV status among MSM. Specifically, we hypothesized that higher perceived discrimination against gay and bisexual men would lead to psychological distress among these men and thus precipitate participation in risky sexual activities. However, our study found no practically or statistically significant associations. This lack of a relationship was robust to the introduction or removal of covariates and random slopes for race/ethnicity as well as the parsing of perceived discrimination into overall and partial measures.

Our findings run contrary to previous findings that community tolerance of gay and bisexual men are negatively and significantly associated with the rate of male-to-male transmission of HIV (27) and that internalized homonegativity is positively associated with sexual risk-taking (4-10). This lack of agreement might be due to our relatively short survey, which, while amenable to quick administration online, might not capture the true range of perceptions of interpersonal discrimination as they relate to HIV status. In addition, MSAs and Metro Divisions might represent too large an area for the relationship between community-based discrimination and HIV status among MSM. Perhaps city or even neighborhood is a more germane level.

Finally, while perceived discrimination data were collected in late 2011 and early 2012, information on HIV status was collected in 2008. There have been substantial changes in the acceptance of gay men, lesbians, and bisexuals in many areas of the country between 2008 and today. Areas that may have evinced higher discrimination in 2008 may be seen as less discriminatory today. This earlier higher discrimination might have been associated with HIV status when it was measured in 2008 but not with less perceived discrimination in evidence today.

To date, there has been no quantitative research into the association of perceptions of community-based interpersonal discrimination against gay and bisexual men with HIV status among MSM at the individual level. One theory supporting such an association is that the less accepting of gay and bisexual men a community is, the more likely that MSM are to be driven “underground” and engage in high risk sex (27). The analyses based on the data collected from the survey and combined with the NHBS-MSM2 dataset represent an important first step, indicating that such a relationship may not actually exist.

Certain other theoretical approaches may be more in line with our finding that there is no association between perceptions of discrimination at the community level and HIV status among MSM at the individual level. For instance, a more accepting environment may encourage previously inexperienced MSM to enter the pool of potential sex partners (27). These MSM are less likely to be HIV-positive and their entry into the pool of sexual partners would reduce the overall percentage of HIV-positive MSM (27). Alternatively, coming out may increase the risk of HIV acquisition if not, immediately, HIV prevalence.

Study Strengths

Our study has a number of strengths. First, it was broad in geographic scope. The NHBS-MSM2 sample was comprised of 9,390 MSM living in 18 of the 21 MSAs representing 66% of urban AIDS prevalence in the US (23). Perceptions of interpersonal discrimination were based on 1,628 unique survey responses received from gay and bisexual men in these same 18 counties. Second, our study used a relatively novel method of collecting data on perceived interpersonal discrimination against gay and bisexual men – online recruitment and survey administration. Finally, this study is the first to apply multilevel modeling techniques to explore perceptions of interpersonal discrimination aggregated at the community level with HIV status at the individual level.

Study Limitations

The study has a number of limitations. First, HIV status was determined based on data collected in 2008, but perceptions of discrimination were measured and aggregated in late 2011 and early 2012. If perceptions of discrimination had been measured concomitantly with HIV status (i.e., in late 2011 and early 2012), perceptions of discrimination would remain the same, but HIV prevalence would be greater than in 2008. This would likely result in a stronger association between HIV status and perceived discrimination. Alternatively, if both had been measured in 2008, HIV prevalence would have remained the same, but perceptions of discrimination would likely have been greater (3, 27), resulting in a weaker association between HIV and perceived discrimination.

Second, the measure of perceived discrimination has not been widely tested. Although we performed the analyses using overall and partial perceived discrimination scores, further research should be conducted to determine if any of the elements of this instrument can be fit into meaningful groupings. As such, a factor or latent class analysis would make a helpful next step. In addition, modeling an outcome more immediately associated with perceptions of discrimination, such as sexual risk behaviors, might have shown a stronger, positive association.

Next, HIV status was based on testing for 89.2% of the NHBS-MSM2 sample. The other 10.8% were based on self-reported HIV status. The degree of accuracy among these self-reporters could affect the study results. Among all NHBS-MSM2 respondents who self-reported HIV status and received an HIV test result, 92.3% of those who self-reported as negative tested negative and 89.1% of those who self-reported as positive tested positive. If such percentages were to be repeated in the 10.8% of respondents for whom HIV status was based solely on self-report, the lack of association would not be affected. However, if self-reporters were more likely to be positive but report negative, then the association is likely being understated. On the other hand, if self-reporters were more likely to be negative but report positive, then the association is likely being overstated.

Another major limitation is the lack of representativeness of either the NHBS-MSM2 dataset or survey responses. Although NHBS-MSM2 was conducted over a broad geographic scope, it concentrated on the core areas of the HIV epidemic in each MSA or Metro Division. In this way, it is not generalizable to the HIV epidemic among all MSM in the US. Also, previous research has shown that there may be some bias in online recruitment of black, non-Hispanic, and Hispanic survey respondents (28). For our study, race/ethnicity was not collected on any of the disqualified respondents. However, among the full completers, 71.7% considered themselves to be non-Hispanic white and 6.4% non-Hispanic black. Of the 296 partial completers who provided race/ethnicity, 62.2% considered themselves to be non-Hispanic white and 7.1% non-Hispanic black. However, HIV prevalence is much higher among non-Hispanic black MSM (2). These men are also likely to perceived discrimination differently (29). These two phenomena would seem to indicate a stronger association between perceived discrimination and HIV status than what was found, but the fact that HIV status was not measured among those men whose survey responses comprised the cluster level discrimination scores may obscure this to some degree.

Also, our study explored HIV prevalence rather than incidence. According to existing hypotheses (4-10), perceptions of discrimination may motivate men to locate themselves in difficult sexual situations or participate in risky sexual behaviors. In this way, perceived discrimination is likely to precede acquisition of HIV. From this theoretical perspective, the association of perceived discrimination with prevalent HIV infection may be less clear.

Another limitation is the relatively small number of clusters (i.e., MSAs and Metro Divisions). Using only 18 MSAs and Metro Divisions in the analyses meant we had to limit the number of area-level exposures in the models. As such, we were unable to control for the presence or absence of other area-level factors such as structural discrimination and residential segregation (so-called “gay ghettos”). Also, we had to limit the number of random slopes included in any particular model. Therefore, we decided to include only one random slope (race/ethnicity) when applicable.

Next, we did not account for the different stage of the HIV epidemic across the 18 MSAs and Metro Divisions. While the early HIV epidemic predominated in areas such as Los Angeles, San Francisco, and New York City, the distribution of HIV incidence and prevalence has changed over the past 30 years. Future studies accounting for area-level effects on HIV prevalence and incidence should explore ways to control for the stage of the epidemic in each area of interest. In addition, a phenomenon not accounted for in this study is that lower perceived discrimination against gay and bisexual men in certain areas might motivate gay and bisexual men to move to those areas. Since HIV is positively correlated with the size of an area’s gay population, such in-migration might increase HIV prevalence (27). Such migration could be obscuring an actual association. Methods to address this hypothesized phenomenon should be explored in the future.

CONCLUSIONS

Despite prior research (4-10, 27) indicating that a link between community level perceptions of discrimination against gay and bisexual and HIV status was likely to exist among MSM, our study found no significant association between community-based interpersonal discrimination and HIV status. Considering potentially opposing theories regarding the discrimination-HIV link as well as our study's limitations, further research measuring the relationship between perceptions of discrimination at the community level and HIV incidence and prevalence at the individual level among different MSM populations across the US is needed. Such further research could measure perceptions of discrimination prior to the ascertainment of HIV status and focus on smaller areas such as cities or neighborhoods. It might also explore individual level perceptions of discrimination and use a more robust survey instrument.

REFERENCES

1. Hall HI, Song R, Rhodes P, Prejean J, An Q, Lee LM, et al. Estimation of HIV incidence in the United States. JAMA. 2008;300(5):520-9.
2. Prejean J, Song R, Hernandez A, Ziebell R, Green T, Walker F, et al. Estimated HIV incidence in the United States, 2006-2009. PLoS One. 2011;6(8):e17502.
3. Glick SN, Golden MR. Persistence of racial differences in attitudes toward homosexuality in the United States. J Acquir Immune Defic Syndr. 2010;55(4):516-23.
4. Huebner DM, Davis MC, Nemeroff CJ, Aiken LS. The impact of internalized homophobia on HIV preventive interventions. Am J Community Psychol. 2002;30(3):327-48.
5. Meyer IH, Dean L. Internalized homophobia, intimacy, and sexual behavior among gay and bisexual men. In: Herek GM, editor. Stigma and Sexual Orientation: Understanding Prejudice Against Lesbians, Gay Men and Bisexuals. Thousand Oaks, CA: Sage; 1998.
6. Waldo CR, Kegeles SM, Hays RB. Self-acceptance of gay identity predicts decreased sexual risk behavior and increased psychological health in U.S. young gay men. 12th International AIDS Conference. Geneva, Switzerland. 1998.
7. Stokes JP, Peterson JL. Homophobia, self-esteem, and risk for HIV among African American men who have sex with men. AIDS Educ Prev. 1998;10(3):278-292.

8. Herek GM, Glunt EK. Identity and community among gay and bisexual men in the AIDS era: preliminary findings from the Sacramento Men's Health Study. In: Herek GM, B. G, editors. Psychological Perspectives on Lesbian and Gay Issues: AIDS, Identity, and Community: The HIV Epidemic and Lesbians and Gay Men. Thousand Oaks, CA: Sage; 1995. p. 55-84.

9. Herek GM. Confronting sexual stigma and prejudice: Theory and practice. J Soc Issues. 2007;63(4):905-925.

10. Weinberg GH. Society and the healthy homosexual. New York,: St. Martin's Press; 1972.

11. Burn SM, Kadlec K, Rexer R. Effects of subtle heterosexism on gays, lesbians, bisexuals. J Homosex. 2005;49(2):23-38.

12. Rotheram-Borus MJ, Reid H, Rosario M, Kasen S. Determinants of safer sex patterns among gay/bisexual male adolescents. J Adolesc. 1995;18:3-15.

13. Folkman S, Chesney M, Pollack L, Coates T. Stress, control, coping, and depressive mood in Human Immunodeficiency Virus-positive and Virus-negative gay men in San-Francisco. J Nerv Ment Dis. 1993;181(7):409-416.

14. Ickovics J, Beren S, Grigorenko E, Morrill A, Druley J, Rodin J. Pathways of risk: race, social class, stress, and coping as factors predicting heterosexual risk behaviors for HIV among women. AIDS Behav. 2002;6:339-50.

15. Hatzenbuehler ML. How does sexual minority stigma "get under the skin"? A psychological mediation framework. Psychol Bull. 2009;135(5):707-30.

16. Meyer IH. Minority stress and mental health in gay men. J Health Soc Behav. 1995;36(1):38-56.

17. Huebner DM, Rebchook GM, Kegeles SM. Experiences of harassment, discrimination, and physical violence among young gay and bisexual men. Am J Public Health. 2004;94(7):1200-3.

18. Diaz RM, Ayala G, Bein E. Sexual risk as an outcome of social oppression: data from a probability sample of Latino gay men in three U.S. cities. Cultur Divers Ethnic Minor Psychol. 2004;10(3):255-67.

19. Preston DB, D'Augelli AR, Kassab CD, Starks MT. The relationship of stigma to the sexual risk behavior of rural men who have sex with men. AIDS Educ Prev. 2007;19(3):218-30.

20. Burchell AN, Calzavara LM, Myers T, Remis RS, Raboud J, Corey P, et al. Stress and increased HIV infection risk among gay and bisexual men. AIDS. 2010;24(11):1757-64.

21. Inzlicht M, McKay L, Aronson J. Stigma as ego depletion: how being the target of prejudice affects self-control. Psychol Sci. 2006;17(3):262-9.

22. Baumeister RF, DeWall CN, Ciarocco NJ, Twenge JM. Social exclusion impairs self-regulation. J Pers Soc Psychol. 2005;88(4):589-604.

23. Centers for Disease Control and Prevention. National HIV Behavioral Surveillance System: Men Who Have Sex with Men (NHBS-MSM2): Model Surveillance Protocol: NCHHSTP/DHAP/BCSB/Behavioral Surveillance Team; 2008.

24. MacKellar DA, Gallagher KM, Finlayson T, Sanchez T, Lansky A, Sullivan PS. Surveillance of HIV risk and prevention behaviors of men who have sex with men--a national application of venue-based, time-space sampling. Public Health Rep. 2007;122 Suppl 1:39-47.

25. Sullivan PS. Personal Communication. March 30, 2012.

26. Kleinbaum DG, Klein M. Logistic Regression: A Self-Learning Text. Third ed. New York: Springer; 2010.

27. Francis AM, Mialon HM. Tolerance and HIV. J Health Econ. 2010;29(2):250-67.

28. Sullivan PS, Khosropour CM, Luisi N, Amsden M, Coggia T, Wingood GM, et al. Bias in online recruitment and retention of racial and ethnic minority men who have sex with men. J Med Internet Res. 2011;13(2):e38.

29. Rao D, Pryor JB, Gaddist BW, Mayer R. Stigma, secrecy, and discrimination: ethnic/racial differences in the concerns of people living with HIV/AIDS. AIDS Behav. 2008;12(2):265-71.

TABLES AND FIGURES

Table 1. Overall and Partial Perceived Discrimination against Gay and Bisexual Men, 18 United States Metropolitan Statistical Areas and Metropolitan Divisions, November 2011-January 2012 (N=1,624)

	MSA/Metro Division	Survey Respondents	Overall Perceived Discrimination Score	Partial Perceived Discrimination Score
1	Atlanta	77	43.8	24.2
2	Baltimore	85	45.3	24.5
3	Boston	75	40.1	18.9
4	Chicago	84	38.4	20.3
5	Dallas	75	46.0	26.2
6	Denver	80	39.2	21.9
7	Detroit	75	48.5	27.9
8	Houston	82	45.6	25.8
9	Los Angeles	83	40.8	22.2
10	Miami	76	42.7	23.1
11	New Orleans	54	41.2	23.0
12	New York	207	36.2	19.5
13	Philadelphia	78	43.4	23.4
14	St. Louis	73	47.3	26.0
15	San Diego	82	38.9	20.9
16	San Francisco	81	33.2	16.7
17	Seattle	91	36.9	18.9
18	Washington, DC	170	36.9	18.8
	Total	**1,628**	**41.3**	**22.3**

Table 2. NHBS-MSM2 (2008) Sample Characteristics, 18 United States Metropolitan Statistical Areas and Metropolitan Divisions (N=9,390)

	HIV+	HIV-	*p-value**
Age			
60 years and older	13.1%	86.9%	**<0.05**
50 to 59 years	27.9%	72.1%	
40 to 49 years	27.1%	72.9%	
35 to 39 years	21.1%	78.9%	
30 to 34 years	19.3%	80.7%	
25 to 29 years	14.7%	85.3%	
18 to 24 years	10.7%	89.4%	
Race/Ethnicity			
black, not Hispanic	26.2%	73.8%	**<0.05**
Hispanic	18.2%	81.8%	
other	17.0%	83.0%	
white, not Hispanic	16.2%	83.8%	
Annual Income			
$0 to $14,999	28.3%	71.9%	**<0.05**
$15,000 to $39,999	19.8%	80.2%	
$40,000 to $74,999	15.1%	85.0%	
$75,000 or more	13.9%	86.1%	
Employment Status			
unemployed, retired, disabled for work, or other	32.0%	68.0%	**<0.05**
employed full- or part-time, homemaker, or full-time student	16.7%	83.3%	
Non-injection Drug Use Past 12 Months			**<0.05**
yes	22.4%	77.6%	
no	16.1%	84.0%	
Out to Others			
told anybody attracted to or have sex with men	19.4%	80.6%	**0.02**
told nobody attracted to or have sex with men	15.3%	84.7%	

*Chi-square test for trend (α=0.05)

Table 3. HIV Prevalence by Levels of Overall and Partial Perceived Discrimination against Gay and Bisexual Men among NHBS-MSM2 (2008) Respondents, 18 United States Metropolitan Statistical Areas and Metropolitan Divisions (N=9,390)

	N	HIV+	HIV-	*p-value*
overall perceived discrimination score				
above 75th percentile	2,377	23.9%	76.1%	**<0.05**
median to 75th percentile	2,562	16.5%	83.5%	
25th percentile to less than median	2,595	17.3%	82.7%	
below 25th percentile	1,856	19.4%	80.6%	
partial perceived discrimination score				
above 75th percentile	1,842	21.2%	78.8%	**<0.05**
median to 75th percentile	3,097	19.4%	80.6%	
25th percentile to less than median	1,781	18.5%	81.5%	
below 25th percentile	2,670	17.9%	82.1%	

Table 4. Multilevel Logistic Regression Results: Full, Reduced, and Final Models for Association of HIV Status with Overall Score for Perceived Discrimination against Gay and Bisexual Men, 18 United States Metropolitan Statistical Areas and Metropolitan Divisions

	full model*,+		final model*,+		reduced model***	
exposure/covariate	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
overall perceived discrimination score	1.00	(0.96-1.03)	1.00	(0.96-1.04)	1.00	(0.96-1.04)
age	1.34	(1.28-1.40)	-	-	-	-
race/ethnicity	1.21	(1.11-1.32)	1.13	(1.04-1.23)	-	-
annual income	1.31	(1.23-1.40)	-	-	-	-
employment	1.72	(1.44-2.06)	2.11	(1.73-2.57)	-	-
non-injection drug use	1.54	(1.43-1.66)	-	-	-	-
out to others	2.04	(1.43-2.90)	-	-	-	-

*Full model contains overall perceived discrimination score as the exposure and age, race/ethnicity, annual income, employment, non-injection drug use, and out to others as covariates.
**Final model contains overall perceived discrimination score as the exposure and race/ethnicity and employment as covariates.
***Reduced model contains overall perceived discrimination score as the exposure and no other covariates.
+random slope for race/ethnicity; OR=odds ratio; CI=confidence interval

Table 5. Multilevel Logistic Regression Results: Full, Reduced, and Final Models for Association of HIV Status with Partial Score for Perceived Discrimination against Gay and Bisexual Men, 18 United States Metropolitan Statistical Areas and Metropolitan Divisions

	full model*,+		final model**		reduced model***	
exposure/covariates	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
partial perceived discrimination score	1.00	(0.95-1.05)	1.00	(0.95-1.05)	1.01	(0.96-1.07)
age	1.34	(1.28-1.40)	1.28	(1.22-1.35)	-	-
race/ethnicity	1.21	(1.11-1.32)	-	-	-	-
annual income	1.31	(1.23-1.40)	1.48	(1.39-1.57)	-	-
employment	1.74	(1.44-2.06)	-	-	-	-
non-injection drug use	2.04	(1.43-1.66)	-	-	-	-
out to others	1.54	(1.43-2.90)	-	-	-	-

*Full model contains partial perceived discrimination score as the exposure and age, race/ethnicity, annual income, employment, non-injection drug use, and out to others as covariates.

**Final model contains partial perceived discrimination score as the exposure and age and annual income as covariates.

***Reduced model contains partial perceived discrimination score as the exposure and no other covariates.

+random slope for race/ethnicity; OR=odds ratio; CI=confidence interval

Figure 1A. Facebook Banner Advertisement #1 for Survey of Perceived Discrimination against Gay and Bisexual Men

Figure 1B. Facebook Banner Advertisement #2 for Survey of Perceived Discrimination against Gay and Bisexual Men

Figure 1C. Facebook Banner Advertisement #3 for Survey of Perceived Discrimination against Gay and Bisexual Men

Figure 1D. Facebook Banner Advertisement #4 for Survey of Perceived Discrimination against Gay and Bisexual Men

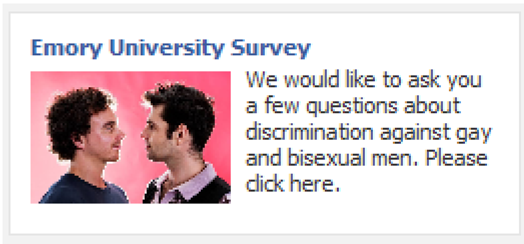


Figure 1E. Facebook Banner Advertisement #5 for Survey of Perceived Discrimination against Gay and Bisexual Men

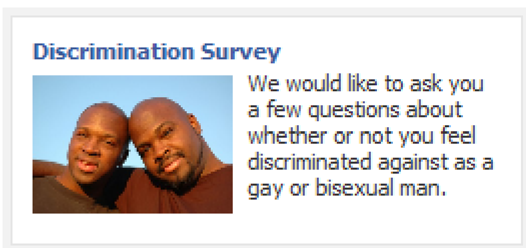


Figure 1F. Facebook Banner Advertisement 6 for Survey of Perceived Discrimination against Gay and Bisexual Men

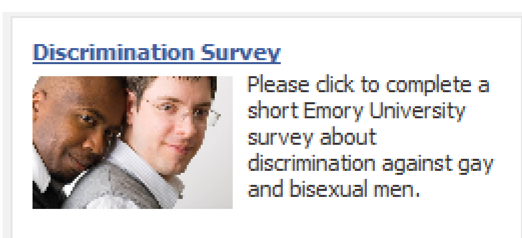


Figure 2. HIV Status among Men who Have Sex with Men by Overall Perceived Discrimination against Gay and Bisexual Men, 18 United States Metropolitan Statistical Areas and Metropolitan Divisions

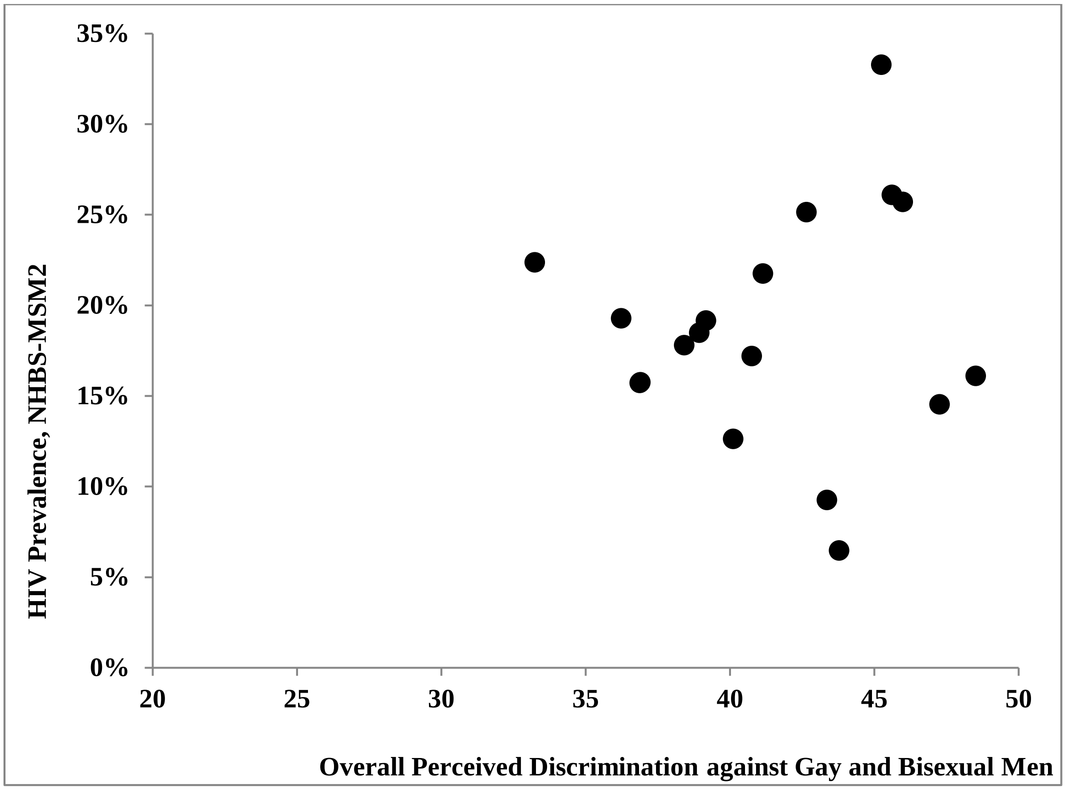
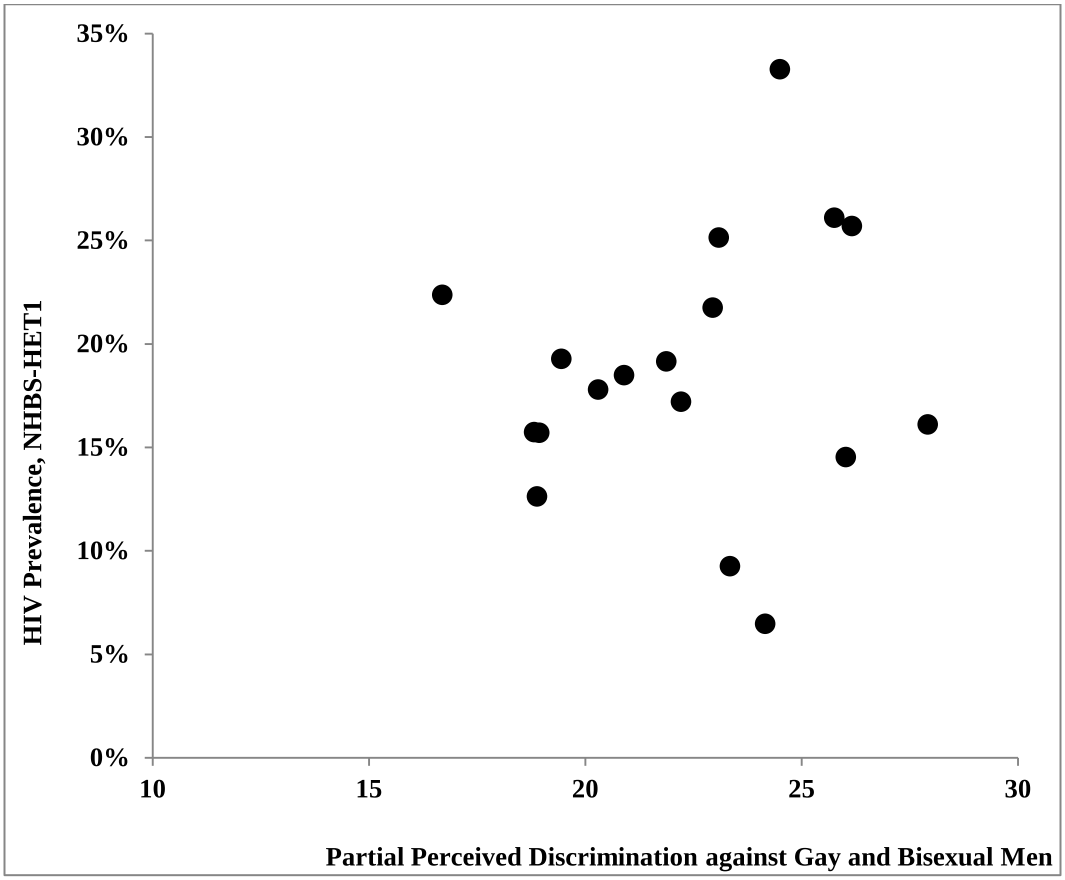


Figure 3. HIV Status among Men who Have Sex with Men by Partial Perceived Discrimination against Gay and Bisexual Men, 18 United States Metropolitan Statistical Areas and Metropolitan Divisions



CHAPTER 5

Paper #3

Structural Discrimination and HIV Prevalence among Men who Have Sex with Men in the United States

Structural Discrimination and HIV Prevalence among Men who Have Sex with Men in the United States

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SYNOPSIS

Objective: The purpose of this study was to assess the association between three forms of structural discrimination against gay and bisexual men with HIV status at the individual level among men who have sex with (MSM) in 20 United States Metropolitan Statistical Areas.

Methods: We measured three forms of structural discrimination – overall discrimination; recognition of same-sex partner rights; and prohibition of same-sex marriage. HIV status and individual level covariates were derived from the MSM National HIV Behavioral Surveillance System (NHBS-MSM2) conducted in 2008. Multilevel logistic regression analyses were run to assess the association between structural discrimination and HIV status among MSM.

Results: Among non-Hispanic white MSM, the association between prohibition of same-sex marriage and HIV status was positive and significant (OR=1.24 (95% CI: 1.05-1.47). The recognition of rights for same-sex partners was positively but not significantly associated with HIV status among respondents who are employed full- or part-time, full-time homemaker, or fulltime student (OR=1.10 (95% CI: 0.94-1.30)).

Conclusions: The association between prohibition of same-sex marriage and HIV status among non-Hispanic white men might indicate that the repeal of legal prohibitions against same-sex marriage could reduce HIV prevalence in areas where such prohibitions

are currently in effect. Alternatively, areas seen as having more compassionate or permissive laws might attract MSM, thus increasing HIV prevalence. This could be causing the observed association seen or could be obscuring a true association. Given the dearth of prior research into the structural discrimination-HIV link, lack of consistency in our findings, and certain study limitations, further research is warranted.

INTRODUCTION

Structural discrimination can be defined as the laws, policies, norms, attitudes, and behaviors in governmental institutions and other societal entities which hinder individuals and groups from obtaining rights and opportunities equal to those held by the majority population (1). Such discrimination against gays and lesbians in the US has taken several forms. Rights that are abrogated for gays and lesbians or have been abrogated in the recent past include consensual adult sexual relations; marriage and/or the legal and social benefits of marriage; retention of child custody and/or adoption; and freedom from discrimination in housing, education, and employment (2). One study found that three HIV risk behaviors were significantly lower among MSM who reported having a domestic partner than among men without a domestic partner (3). Another study exploring the link between officially recognized same-sex partnerships and rates of HIV, gonorrhea, and syphilis in nine Western European countries between 1989 and 2003 found that rates of HIV decreased in countries that adopted same-sex partnership laws relative to countries that did not (4). A third study showed that prohibition of same-sex marriage in the US is positively, although not always statistically significantly, associated with the HIV rate in particular areas (5).

The vast majority of the more than 400,000 same-sex couples in the US are not officially recognized by the states or municipalities in which they live (6). Currently, eight states (Connecticut, Iowa, Maryland, Massachusetts, New Hampshire, New York, Vermont, and Washington) and the District of Columbia (DC) sanction same-sex marriage (7-10).

Same-sex civil unions are permitted in Delaware, Hawaii, Illinois, New Jersey, and Rhode Island (10). Also, California, Nevada, and Oregon, offer broad domestic partnership laws and Colorado, Maine, and Wisconsin confer limited statewide spousal rights to same-sex couples (10).

It is hypothesized that the availability of legally recognized same-sex partnerships would reduce HIV risk by offering certain important economic and emotional benefits and thus encouraging monogamy (3, 4, 11). Same-sex partnerships laws could reduce the stigma associated with homosexuality and decrease the motivation for MSM to engage in clandestine, high-risk sex acts, thus decreasing their HIV risk (4, 12). Structural discrimination might also foster depression, which, in turn, has been linked with participation in risky sex (13, 14). Alternatively, the degree of recognition of same-sex partnerships and explicit prohibition of same-sex marriage, although also possibly linked to depression, might be more directly linked with sexual partnering choices and behaviors (3-5, 15). Whereas prior studies have focused on the association of structural discrimination in the form of the lack of same-sex partnership recognition or prohibition of same-sex marriage with area level rates of HIV acquisition, our study evaluated the association of overall structural discrimination, recognition of same-sex partnerships, and prohibition of same-sex marriage with HIV status among MSM at the individual level in 20 US Metropolitan Statistical Areas (MSAs) and Metropolitan (Metro) Divisions in 2008.

METHODS

Multilevel logistic regression models were developed to evaluate the association of three measures of structural discrimination – overall structural discrimination; recognition of same-sex partnerships; and prohibition of same-sex marriage – against gay and bisexual men with HIV status among MSM. Such measures were considered for states associated with main cities of 20 MSAs and Metro Divisions covered by the National HIV Behavioral Surveillance System (NHBS-MSM2) conducted among MSM in 2008. Data collection for NHBS-MSM2 was conducted in 2008 among the 21 MSAs and Metro Divisions that, together, represent 66% of urban AIDS prevalence in the US (16). NHBS-MSM2 respondents were limited to men ages 18 years of age and older living within the sampling frames of the 20 MSAs and Metro Divisions. HIV status and individual level covariates were derived from NHBS-MSM2. NHBS methods have been described in greater detail elsewhere (17).

Outcome of Interest: HIV Status

For all model analyses, the outcome of interest was HIV status (positive/negative), which was based on HIV testing and interviews conducted as part of NHBS-MSM2. Preference was given to test results. That is, if both a test result and self-report were available and not in agreement for a particular respondent, the test result was used.

Exposure of Interest: Structural Discrimination against Gay and Bisexual Men

Three types of structural discrimination against gay and bisexual men were considered – overall structural discrimination; recognition of same-sex partnerships; and prohibition of same-sex marriage. The overall index of structural discrimination incorporated laws and policies prohibiting hate or bias crimes, housing discrimination, or employment discrimination based on sexual orientation as well as laws pertaining to the adoption of children by same-sex partners (Table 1). The overall index also included the measures of same-sex partnership recognition and prohibition of same-sex marriage. Laws recognizing same-sex partnerships were specified on an ordinal scale composed of four groups – no express recognition of same-sex partnerships; extension of some rights to same-sex couples; extension to same-sex couples of rights equivalent to those extended to opposite-sex couples; and issuance of marriage licenses to same-sex couples. Prohibition of same-sex marriage were coded in three ordinal categories – constitutional amendment restricting marriage to one man and one woman; state law or policy restricting marriage to one man and one woman; or no express prohibition of same-sex marriage.

The overall structural discrimination index, same-sex partnership recognition, prohibition of same-sex marriage were coded so that higher values indicated higher hypothesized structural discrimination. The overall index could range from zero to nine. The same-sex partnership recognition and same-sex marriage prohibition measures could range from zero to three and zero to two, respectively. The scores were derived from our review and coding of a number of state level measures (18). A state was assigned to an MSA or

Metro Division based on the MSA or Metro Division's main city. In all, the 20 MSAs and Metro Divisions of interest were linked to 16 states and territories. We reviewed all laws and policies collated by HRS to ensure that they were in effect in 2008, when NHBS-MSM2 was conducted.

Potential Individual Level Effect Modifiers and Confounders

Data on all individual level factors were derived from NHBS-MSM2. To the degree possible, individual variables were coded so that the highest number corresponded to the highest theorized likelihood of positive HIV status. Age was considered as an ordinal variable. Race/ethnicity was operationalized as non-Hispanic black; Hispanic; other; and non-Hispanic white. Employment status was operationalized as unemployed, retired, disabled for work, or other, and as employed full- or part-time, full-time homemaker or full-time student. Although substance use may lie in the causal pathway between perceptions of discrimination and HIV, self-reported non-injection drug use (yes/no) in the past 12 months was included as a potential confounder.

Analyses

Considering the multilevel aspects of the combined dataset as well as the presumed correlation of observations within each MSA or Metro Division, multilevel logistic regression models were developed to assess the association between HIV status and the measures of structural discrimination while controlling for certain individual level variables. Each of the three measures of structural discrimination was considered as a single exposure in separate models. Descriptive statistics were calculated and model analyses performed with SAS® version 9.2. The SAS® GLIMMIX procedure was utilized to account for random effects resulting from the nesting of the two levels. Because data were cross-sectional, we chose to fit all models with an exchangeable correlation structure. Collinearity was evaluated using condition indices (cut point = 30) and variance decomposition proportions (cut point = 0.50) (19). Interaction was assessed using "chunk" tests for groups of interaction terms and then manual backward elimination based on the score test for individual interaction terms (19). For each of three separate models (for the outcomes overall structural discrimination, same-sex partnership recognition, same-sex marriage prohibition), four variables (race/ethnicity, annual income, employment status, and outness) were considered in interaction terms with the relevant measure of structural discrimination.

Next, three sets of tables of odds ratios (ORs) were created to assess "full" (i.e., all variables included) and "reduced" (i.e., only exposure of interest included) models as well as models containing all possible combinations of covariates for each measure of structural discrimination. The OR for structural discrimination generated by each model and its corresponding 95% confidence interval (CI) were evaluated against the relevant full model in terms of proximity to the full model OR, precision as measured by CI width, and parsimony (i.e., number of variables in the model).

Certain models were also considered further by evaluating the inclusion of a random slope. The inclusion of a random intercept or random slope in a multilevel model indicates which effects should be considered while accounting for variability across MSAs or Metro Divisions. All models included a random intercept. We did not include a random slope for any of the area level measures of structural discrimination. However, we did evaluate the inclusion of a random slope for race/ethnicity because the relationship between HIV status and race/ethnicity likely varies markedly across MSAs and Metro Divisions.

RESULTS

Descriptive Statistics

The mean overall structural discrimination index was 4.95 (SD=2.87); the mean partnership recognition index 2.35 (SD=1.04, range: 0-3); and the mean same-sex marriage prohibition index 1.25 (SD=0.92, range: 0-2) (Table 2). The total sample size for the NHBS-MSM2 respondents included in the analyses was 9,390 with an overall HIV prevalence of 19.2%. Valid HIV test results were available for 89.2% of respondents. HIV prevalence was lowest among MSM ages 18-24 years (10.65%) and highest among those ages 50-59 years (27.10%). HIV prevalence was significantly associated with race/ethnicity ($p<0.05$). HIV status was also significantly associated with annual income ($p<0.05$), employment status ($p<0.05$), and the use of non-injection drugs in the past 12 months ($p<0.05$). Those MSM who are out to at least one other person were significantly more likely to be HIV-positive than those who are out to no persons ($p<0.05$).

HIV prevalence was lowest in areas where overall structural discrimination was highest (Table 4). This may be due to the relatively small sample size for these areas (n=371). Alternatively, the highest perceived discrimination might retard participation in risky sexual behaviors, thus decreasing HIV prevalence. Prevalence increased from areas with overall discrimination above the 75th percentile to areas where discrimination was between the median and 75th percentile and then decreased as overall structural discrimination decreased. The overall trend was statistically significant ($p<0.05$). For same-sex partnership recognition ($p<0.05$) as well as prohibition of same-sex marriage ($p<0.05$), HIV prevalence fell as the theorized level of structural discrimination fell.

Model Development

After collinearity was evaluated, three of the interaction terms – those including race/ethnicity, income, and employment status – remained in each of the three models. Once interaction was evaluated, the interaction term including employment status remained in the models for the overall discrimination and partnership recognition models and the interaction term for race/ethnicity remained in the marriage prohibition model. Since an interaction term remained in each models, odds ratios ORs were compared in a stratified fashion.

The inclusion of a random slope for race/ethnicity in the models for overall structural discrimination and recognition of same-sex partnerships did not substantively change the relevant ORs or widen the corresponding 95% CIs for the models considered for either stratum of employment status. In addition, although the random slope for race/ethnicity was statistically significant for the full overall discrimination ($p<0.05$) and same-sex partnership recognition ($p<0.05$) models where employment status was unemployed, retired, disabled for work, other it was not statistically significant for the overall discrimination ($p>0.05$) and same-sex partnership recognition ($p>0.05$) models where employment status was employed full- or part-time, full-time student, or full-time homemaker. The random slope for race/ethnicity was not statistically significant for either final overall discrimination model (p>0.05 where employment status was unemployed, retired, disabled for work, other; and where employment status was employed full- or part-time, full-time student, or full-time homemaker. The random slope for race/ethnicity could not be included in the final model for same-sex partnership recognition because this model did not include race/ethnicity. Because race/ethnicity figured in a significant interaction term for the same-sex marriage prohibition exposure and relevant model analyses were therefore stratified based on race/ethnicity, a random slope for race/ethnicity could not be introduced.

For the overall structural discrimination index, the perceived discrimination OR for those unemployed, retired, disabled for work, or other was 0.95 (95% CI: 0.88-1.02) (Table 5). The ORs for those employed full- or part-time, full-time homemakers, or full-time students was not substantively different – 1.00 (95% CI: 0.93-1.08). However, although race/ethnicity was positively and significantly associated with HIV status among those employed full- or part-time, a homemaker, or full-time students (OR=1.16 (95% CI: 1.07-1.27)), race/ethnicity was negatively but not significantly associated with HIV status among those unemployed, retired, disabled for work, or other (OR=0.94 (95% CI: 0.84-1.06)). This result indicates that employment status affects the relationship between HIV status and race.

For the employed/homemaker/student group, the OR for same-sex partnership discrimination was 1.10 (95% CI: 0.94-1.30) (Table 6). For the unemployed/retired/disabled/other group, the OR for same-sex partnership discrimination was 0.95 (95% CI: 0.84-1.29). Although these results his shows that there is a positive association between same-sex partnership recognition and HIV status among those in the employed/homemaker/student group but a negative association among those in the unemployed/retired/disabled/other group, neither association is significant.

Due to the significance of the interaction term involving same-sex marriage prohibition and race/ethnicity, assessment of the association between individual HIV status and explicit prohibition of same-sex marriage was stratified based on race/ethnicity. For non-Hispanic black (OR=1.02, 95% CI: 0.77-1.36) and Hispanic MSM (OR=0.91, 95% CI: 0.76-1.08), prohibition of same-sex marriage was not significantly associated with an individual man’s HIV status (Table 7). Among those MSM for whom race/ethnicity was defined as “other,” the association between same-sex marriage prohibition and individual level HIV status was positive but not statistically significant (OR=1.29 (95% CI: 0.93-1.78)). However, for non-Hispanic white MSM, the association was positive and statistically significant (OR=1.24 (95% CI: 1.05-1.47)). This indicates the possible presence of a relationship between prohibition of same-sex marriage among non-Hispanic white MSM but likely not among other MSM.

All full, final, and reduced models were also run using the SAS® GENMOD procedure. Results were similar to those obtained using the SAS® GLIMMIX procedure.

DISCUSSION

The purpose of this study was to assess the association between three forms of structural discrimination against gay and bisexual men – (1) overall structural discrimination; (2) extent of same-sex partnership recognition; and (3) prohibitions against same-sex marriage – with HIV status among MSM. We found no association between the overall structural discrimination index and HIV status. Although there was a positive association between same-sex partnership recognition and HIV status among those in the employed/homemaker/student group, it was not significant. The association between prohibition of same-sex marriage and individual HIV status was not significant for non-Hispanic black, Hispanic, and other non-white MSM, but the association between prohibition of same-sex marriage and a man's HIV status was positive and significant among non-Hispanic white MSM. Specifically, the odds of being exposed to a one-unit higher value of the same-sex marriage prohibition index were 24% higher among HIV-positive MSM than among HIV-negative MSM. These results did not change substantively when model covariates were added or removed.

Our findings related to the prohibition of same-sex marriage and HIV among non-Hispanic white men are consistent with prior research. Our other findings are not. However, this prior research has focused on the association between structural discrimination against gay and bisexual men and rates of HIV acquisition rather than HIV status at the individual level. In a study of the relationship between same-sex partnership laws and the rates of HIV in nine Western European countries that introduced a "marriage-like" status between 1989 and 2003, HIV rates dropped in countries that adopted such laws relative to countries that did not (4). Another study showed that prohibition of same-sex marriage is positively, although not always statistically significantly, associated with the rate of male-to-male HIV transmission in particular areas of the US (5).

The racial and ethnic disparity in the association between same-sex marriage prohibition and HIV status might be driven by a number of different factors. In particular, non-Hispanic whites might be more susceptible than other groups to prohibition of same-sex marriage because they have fewer types of discrimination about which to worry (20). In addition, although, rates of new HIV diagnoses and the prevalence of men living with HIV are both higher among non-Hispanic black MSM than among non-Hispanic white MSM, whites represented 46% of the roughly 30,000 new HIV infections among MSM in 2006 (21). This translates to a minimum pool of 13,800 annual new infections that could potentially be affected by repeal of prohibition of same-sex marriage in states in which such prohibitions are currently in effect.

Study Strengths

There are three main strengths of our study. First, the study sample covered a broad geographic scope in that it included 9,390 MSM living in 20 MSAs and Metro Divisions. Next, our study examined three different types of structural discrimination against gay and bisexual men – (1) overall, based on a number of different measures of structural discrimination; (2) recognition of same-sex partnerships; and (3) constitutional or other legal prohibition of same-sex marriage. Third, this study is the first to use multilevel modeling techniques to assess the relationship of structural discrimination against gay and bisexual men with HIV status among MSM at the individual level.

Study Limitations

This study is subject to certain limitations. First is the relatively small number of clusters for the multilevel analyses (i.e., 20 MSAs and Metro Divisions). This limited our ability to include potential community level confounders of the relationship between structural discrimination and a man's HIV status. It also reduced the number of random slopes that could be introduced during the model development process. To address this, we considered only one random slope – that for race/ethnicity – in the overall structural discrimination and same-sex partnership recognition analyses.

Next, the degree of accuracy among the 10.8% of respondents for whom HIV status was based on self-report rather than an HIV test result could affect our results. Among all NHBS-MSM2 respondents who self-reported HIV status and received an HIV test result, 92.3% of those self-reporting as negative tested negative and 89.1% of those self-reporting as positive tested positive. If similar percentages were seen in the 10.8% of respondents for whom HIV status was based solely on self-report, then any association or lack thereof would not be affected. However, if self-reporters were more likely to be positive but report negative, then the association is likely being understated.

Third, we assessed all laws and policies at the state level rather than a more local level. Even though certain states might have more discriminatory laws, some municipalities within those states might have more permissive laws and policies that apply to residents of those areas. This is an important potential misclassification because permissive local policies might be more influential in terms of the proposed causal pathway than more restrictive state policies. In addition, structural discrimination at the state level might be felt less by residents of the larger cities in which NHBS-MSM2 was conducted than among MSM in other parts of the country. Even when structural discrimination in a particular state is relatively high, its impact in these urban areas may be somewhat attenuated by local policies or attitudes.

Another factor not explored in this study is the possibility that less structural discrimination may spur MSM to migrate into a particular area. MSAs and Metro Divisions viewed as having compassionate or permissive laws related to sexual orientation and same-sex partnering might attract MSM, thus increasing HIV prevalence. Such a phenomenon could possibly obscure a true association.

We also did not account for the different stage of the HIV epidemic across the 20 MSAs and Metro Divisions. While the early HIV epidemic was more impactful in areas like San Francisco and New York, the distribution of HIV incidence and prevalence has changed over the past 30 years. Future studies accounting for area-level effects on HIV prevalence and incidence should explore ways to control for epidemic stage across the areas studied.

Finally, even though it has been hypothesized that legal recognition of same-sex partnerships will likely attenuate HIV acquisition (5), laws recognizing same-sex partnerships might promote the transmission of HIV if greater expectations of fidelity decrease willingness to use condoms or other risk reduction strategies (4, 22). Alternatively, same-sex partnership laws might not substantially increase sexual exclusivity within couples but might change norms so that safe-sex practices are more frequently followed with casual partners (4). Such theories could be explored more fully if sexual risk behaviors were modeled rather than HIV prevalence.

CONCLUSIONS

The association between prohibition of same-sex marriage and HIV status among non-Hispanic white men might indicate that the repeal of legal prohibitions against same-sex marriage could reduce HIV prevalence in areas where such prohibitions are currently in effect. Alternatively, areas seen as having more compassionate or permissive laws might attract MSM, thus increasing HIV prevalence. This could be causing the observed association seen or could be obscuring a true association.

Beyond the link seen in non-Hispanic white MSM, we found no significant association between different forms of structural discrimination against gay and bisexual men and HIV status. Despite this, the single, relatively small, albeit significant, association we found can serve as one piece of evidence in favor of repealing prohibitions against same-sex marriage and as a foundation for further research on the topic. Such research would address the limitations of the current study such as the relatively small number of clusters; the measurement of structural discrimination at the state rather than a more local level; and the failure to account for in- and out-migration of MSM based on structural discrimination in particular areas.

REFERENCES

1. Najcevska M. Structural Discrimination - Definitions, Approaches and Trends (Summary). http://www2.ohchr.org/english/. Accessed March 31, 2012.
2. Blackwell CW, Ricks JL, Dzielgielewski SF. Discrimination of gays and lesbians: a social justice perspective. J Health Soc Policy. 2004;19(4):27-43.
3. Klausner JD, Pollack LM, Wong W, Katz MH. Same-sex domestic partnerships and lower-risk behaviors for STDs, including HIV infection. J Homosex. 2006;51(4):137-44.
4. Dee TS. Forsaking all others? The effects of same-sex partnership laws on risky sex. Econ J. 2008;118(530):1055-1078.
5. Francis AM, Mialon HM. Tolerance and HIV. J Health Econ. 2010;29(2):250-67.
6. Gates GJ. Same-sex couples and the gay, lesbian, bisexual population: new estimates from the American Community Survey. Los Angeles, CA: The Williams Institute, UCLA; 2006.
7. Barbaro M. After long wait, same-sex couples marry in New York. The New York Times. July 24, 2011.
8. Linskey A. O'Malley signs same-sex marriage bill: measure expected to have impact beyond state borders. The Baltimore Sun. March 1, 2012.
9. Turnbull L. Gregoire signs gay marriage into law. The Seattle Times. February 13, 2012.
10. Human Rights Campaign. Issue: Marriage. http://www.hrc.org/issues/marriage. Accessed March 31, 2012.

11. Jaffe HW, Valdiserri RO, De Cock KM. The reemerging HIV/AIDS epidemic in men who have sex with men. JAMA. 2007;298(20):2412-4.

12. Mueller C. An economic analysis of same-sex marriage. German Working Papers in Law and Economics. http://www.bepress.com/gwp/default/vol2002/iss1/art14. Accessed March 31, 2012.

13. Diaz RM, Ayala G, Bein E. Sexual risk as an outcome of social oppression: data from a probability sample of Latino gay men in three U.S. cities. Cultur Divers Ethnic Minor Psychol. 2004;10(3):255-67.

14. Preston DB, D'Augelli AR, Kassab CD, Starks MT. The relationship of stigma to the sexual risk behavior of rural men who have sex with men. AIDS Educ Prev. 2007;19(3):218-30.

15. Stein JA, Nyamathi A, Ullman JB, Bentler PM. Impact of marriage on HIV/AIDS risk behaviors among impoverished, at-risk couples: a multilevel latent variable approach. AIDS Behav. 2007;11(1):87-98.

16. Centers for Disease Control and Prevention. National HIV Behavioral Surveillance System: Men Who Have Sex with Men (NHBS-MSM2): Model Surveillance Protocol: NCHHSTP/DHAP/BCSB/Behavioral Surveillance Team; 2008.

17. MacKellar DA, Gallagher KM, Finlayson T, Sanchez T, Lansky A, Sullivan PS. Surveillance of HIV risk and prevention behaviors of men who have sex with men--a national application of venue-based, time-space sampling. Public Health Rep. 2007;122 Suppl 1:39-47.

18. Human Rights Campaign. Resources: Maps of State Laws and Policies. http://www.hrc.org/resources/entry/maps-of-state-laws-policies. Accessed March 31, 2012.
19. Kleinbaum DG, Klein M. Logistic Regression: A Self-Learning Text. Third ed. New York: Springer; 2010.
20. Rao D, Pryor JB, Gaddist BW, Mayer R. Stigma, secrecy, and discrimination: ethnic/racial differences in the concerns of people living with HIV/AIDS. AIDS Behav. 2008;12(2):265-71.
21. Centers for Disease Control and Prevention. HIV among gay, bisexual and other men who have sex with men (MSM). http://www.cdc.gov/hiv/topics/msm/pdf/msm.pdf. Accessed March 31, 2012.
22. Elford J, Bolding G, Maguire M, Sherr L. Sexual risk behaviour among gay men in a relationship. AIDS. 1999;13(11):1407-11.

TABLES

Table 1. Specification of Components of Structural Discrimination Indices, 20 United States Metropolitan Statistical Areas and Metropolitan Divisions, 2008

Component of Structural Discrimination Indices	Specification
Law or policy offering some degree of recognition of the rights of same-sex partners	=3 if no express recognition of same-sex partnerships in place as of 2008 =2 if some, limited rights extended to same-sex couples as of 2008 =1 if rights equivalent to those extended to opposite-sex couples also extended to same-sex couples as of 2008 =0 marriage licenses extended to same-sex couples as of 2008
Same-sex couples can petition to jointly adopt children	=1 if no in 2008 =0 if yes in 2008
Law or policy prohibiting hate or bias crime based on sexual orientation	=1 if no such law or policy in place as of 2008 =0 if such a law or policy in place as of 2008
Law or policy prohibiting housing discrimination based on sexual orientation	=1 if no such law or policy in place as of 2008 =0 if such a law or policy in place as of 2008
Law or policy prohibiting employment discrimination based on sexual orientation	=1 if no such law or policy in place as of 2008 =0 if such a law or policy in place as of 2008
Constitutional amendment or law/policy restricting marriage to being between one man and one woman	=2 if constitutional amendment in place as of 2008 =1 if a law or policy (but no amendment) in place as of 2008 =0 if no such amendment, law, or policy in place as of 2008

Table 2. Overall and Component Structural Discrimination Indices, 20 United States Metropolitan Statistical Areas and Metropolitan Divisions, 2008

MSA/ Metro Division	Hate Crimes	Housing	Employ-ment	Marriage Restricted	Same-Sex Partners	Joint Adoption	Overall SDI
Atlanta	1	1	1	2	3	1	**9**
Baltimore	0	0	0	1	3	1	**5**
Boston	0	0	0	0	0	0	**0**
Chicago	0	0	0	1	3	0	**4**
Dallas	0	1	1	2	3	1	**8**
Denver	0	0	0	2	3	1	**6**
Detroit	0	1	1	2	3	1	**8**
Houston	0	1	1	2	3	1	**8**
Los Angeles	0	0	0	2	1	0	**3**
Miami	0	1	1	2	3	1	**8**
Nassau-Suffolk	0	0	0	0	3	0	**3**
Newark	0	0	0	0	1	0	**1**
New Orleans	0	1	1	2	3	1	**8**
New York	0	0	0	0	3	0	**3**
Philadelphia	1	1	1	1	3	1	**8**
St. Louis	0	0	1	2	3	1	**7**
San Diego	0	0	0	2	1	0	**3**
San Francisco	0	0	0	2	1	0	**3**
Seattle	0	0	0	0	1	0	**1**
Washington, DC	0	0	0	0	3	0	**3**

Table 3. NHBS-MSM2 (2008) Sample Characteristics, 20 United States Metropolitan Statistical Areas and Metropolitan Divisions (N=9,390)

	HIV+	HIV-	*p-value**
Age			
60 years and older	13.1%	86.9%	**<0.05**
50 to 59 years	27.9%	72.1%	
40 to 49 years	27.1%	72.9%	
35 to 39 years	21.1%	78.9%	
30 to 34 years	19.3%	80.7%	
25 to 29 years	14.7%	85.3%	
18 to 24 years	10.7%	89.4%	
Race/Ethnicity			
black, not Hispanic	26.2%	73.8%	**<0.05**
Hispanic	18.2%	81.8%	
other	17.0%	83.0%	
white, not Hispanic	16.2%	83.8%	
Annual Income			
$0 to $14,999	28.3%	71.7%	**<0.05**
$15,000 to $39,999	19.8%	80.2%	
$40,000 to $74,999	15.1%	85.0%	
$75,000 or more	13.9%	86.1%	
Employment Status			**<0.05**
unemployed, retired, disabled for work, or other	32.0%	68.0%	
employed full- or part-time, homemaker, or full-time student	16.7%	83.3%	
Non-injection Drug Use Past 12 Months			
yes	22.4%	77.6%	**<0.05**
no	16.1%	84.0%	
Out to Others			
told anybody attracted to or have sex with men	19.4%	80.6%	**0.02**
told nobody attracted to or have sex with men	15.3%	84.7%	

*Chi-square test for trend (α=0.05)

Table 4. HIV Prevalence by Levels of Overall Structural Discrimination against Gay and Bisexual Me, Same-Sex Partnership Recognition, and Prohibition of Same-Sex Marriage among NHBS-MSM2 (2008) Respondents, 20 United States Metropolitan Statistical Areas and Metropolitan Divisions (N=9,390)

	N	**HIV+**	**HIV-**	***p-value***
overall structural discrimination				
above 75th percentile	371	6.5%	93.5%	<**0.05**
median to 75th percentile	4,600	21.4%	78.6%	
25th percentile to less than median	3,638	18.6%	81.4%	
below 25th percentile	781	14.5%	85.5%	
same-sex partnership recognition				
no express recognition of same-sex partnerships*	6,953	19.7%	80.4%	<**0.05**
rights equivalent to those extended to opposite sex couples also extended to same-sex couples*	2,144	18.4%	81.6%	
marriage licenses extended to same-sex couples*	293	12.6%	87.4%	
prohibition of same-sex marriage				
constitutional amendment restricting marriage to between one man and one woman*	5,519	19.8%	80.2%	<**0.05**
law or policy (but no amendment) restricting marriage to between one man and one woman*	1,715	19.8%	80.2%	
no amendment, law, or policy restricting marriage to between one man and one woman*	2,156	16.9%	83.1%	

*In place as of 2008.

Table 5. Multilevel Logistic Regression Results for Association of Overall Structural Discrimination and HIV Status among Men who Have Sex with Men, 20 United States Metropolitan Statistical Areas and Metropolitan Divisions, 2008

	Model A* (final)		Model B** (final)	
exposure/covariates	**OR**	**95% CI**	**OR**	**95% CI**
overall structural discrimination	0.95	(0.88-1.02)	1.00	(0.93-1.08)
race/ethnicity	0.94	(0.84-1.06)	1.16	(1.07-1.27)
annual income	1.16	(0.97-1.39)	1.21	(1.14-1.29)

*Model A contains overall structural discrimination as the exposure and race/ethnicity and annual income as covariates for NHBS-MSM2 respondents for whom employment status=unemployed, retired, disabled for work, or other.

**Model B contains overall structural discrimination as the exposure and race/ethnicity and annual income as covariates for NHBS-MSM2 respondents for whom employment status=employed full- or part-time, homemaker, or full-time student.

OR=odds ratio; CI=confidence interval

Table 6. Multilevel Logistic Regression Results for Association of Same-Sex Partnership Recognition and HIV Status among Men who Have Sex with Men, 20 United States Metropolitan Statistical Areas and Metropolitan Divisions, 2008

	Model C* (final)		Model D** (final)	
exposure/covariates	**OR**	**95% CI**	**OR**	**95% CI**
same-sex partnership recognition	0.95	(0.84-1.09)	1.10	(0.94-1.30)
age	1.29	(1.17-1.41)	1.24	(1.20-1.29)
non-injection drug use	1.38	(1.07-1.78)	1.54	(1.39-1.71)

*Model C contains same-sex partnership recognition as the exposure and age and non-injection drug use as covariates for NHBS-MSM2 respondents for whom employment status=unemployed, retired, disabled for work, or other.
**Model D contains same-sex partnership recognition as the exposure and age and non-injection drug use as covariates for NHBS-MSM2 respondents for whom employment status=employed full- or part-time, homemaker, or full-time student.
OR=odds ratio; CI=confidence interval

Table 7. Multilevel Logistic Regression Results for Association of Prohibition of Same-Sex Marriage and HIV Status among Men who Have Sex with Men, 20 United States Metropolitan Statistical Areas and Metropolitan Divisions, 2008

	Model E* (final)		Model F** (final)		Model G*** (final)		Model H+ (final)	
exposure/covariates	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**	**OR**	**95% CI**
prohibition of same-sex marriage	1.02	(0.77-1.36)	0.91	(0.76-1.08)	1.29	(0.93-1.78)	1.24	(1.05-1.47)
age	1.28	(1.20-1.35)	1.38	(1.28-1.49)	1.25	(1.11-1.40)	1.26	(1.20-1.32)
employment status	1.52	(1.34-1.72)	1.32	(0.83-2.11)	2.51	(1.34-4.68)	3.30	(2.54-4.28)

*Model E contains same-sex marriage prohibitions as the exposure and age and employment as covariates for NHBS-MSM2 respondents for whom race/ethnicity=non-Hispanic black.
**Model F contains same-sex marriage prohibitions as the exposure and age and employment as covariates for NHBS-MSM2 respondents for whom race/ethnicity=Hispanic.
***Model G contains same-sex marriage prohibitions as the exposure and age and employment as covariates for NHBS-MSM2 respondents for whom race/ethnicity=other.
+Model H contains same-sex marriage prohibitions as the exposure and age and employment as covariates for NHBS-MSM2 respondents for whom race/ethnicity=non-Hispanic white.
OR=odds ratio; CI=confidence interval

CHAPTER 6

Summary

INTRODUCTION

Men who have sex with men (MSM) and black women are two groups most adversely affected by HIV in the United States (US). Prior research has shown that the HIV disparity between black and white women is not driven solely by differences in individual risk behaviors (1-5). In addition, there is a paucity of effective behavioral interventions aimed at MSM (6). Perhaps more potent community level exposures exist that may be more amendable to effective preventive interventions than are individual level exposures. In light of this, my dissertation aimed to answer three research questions:

1. Is the community sex ratio associated with HIV status among black women?
2. Is perceived discrimination against gay and bisexual men associated with HIV status among MSM?
3. Is structural discrimination against gay and bisexual men associated with HIV status among MSM?

For each research question, I developed multilevel logistic regression models to evaluate the association between HIV status at the individual level and certain community level exposures. For the first study, the exposures were six versions of the male:female sex ratio. The exposures for the second and third research questions were different measures of perceived and structural discrimination, respectively, against gay and bisexual men.

I found no association between any of the sex ratios and HIV status among black women in 29 counties across the US. I also found no association between different measures of perceived discrimination against gay and bisexual men and HIV status among MSM in 18 US Metropolitan Statistical Areas (MSAs) and Metropolitan (Metro) Divisions. For the third question, I found a significant association between same-sex marriage prohibitions and HIV status among non-Hispanic white MSM. However, I found no other significant associations.

ANALYTIC APPROACH

For the first research question, I developed multilevel logistic regression models to evaluate the association between the sex ratio and HIV status among black women. My study used data on black female respondents residing in 29 counties covered by the pilot cycle of the National HIV Behavioral Surveillance System among heterosexuals at increased risk (NHBS-HET1) conducted in 2006-07. Analyses were limited to those counties with 10% or greater of the relevant or Metro Division's black female NHBS-HET1 respondents or counties that were geographically contiguous to more than one county with 10% or more of black female NHBS-HET1 respondents.

The outcome of interest was HIV status at the time of NHBS-HET1 interview. Six different sex ratios were calculated using data from the American Community Survey (ACS). First, a global sex ratio that included males and females of all races and ethnicities was calculated for people of all ages. Next, additional age-specific sex ratios were calculated (i.e., 18 years and older, 18 to 44 years). Third, race-specific sex ratios accounting only for black men and women were calculated for the same age groups (0+ years, 18+ years, and 18-44 years). Data on six individual level variables – age, income, education, employment status, housing status, and last male partner's incarceration history – were derived from NHBS-HET1.

For the second question, I developed multilevel logistic regression models to assess the association between perceived discrimination against gay and bisexual and HIV status among MSM at the individual level. The study was conducted among MSM in 18 of the 25 MSAs and Metro Divisions covered by the MSM National HIV Behavioral Surveillance System (NHBS-MSM2) conducted in 2008. Perceptions of discrimination were based on an online survey conducted in these 18 areas. Survey responses were collected from individuals and then aggregated to calculate average discrimination scores for each area. HIV status and individual level covariates – age, income, employment status, housing status, use of non-injection drugs, and outness to others, were derived from NHBS-MSM2.

To answer my third dissertation research question, multilevel logistic regression models were developed to evaluate the association of three measures of structural discrimination – overall structural discrimination; recognition of same-sex partnerships; and prohibitions against same-sex marriage – against gay and bisexual men with HIV status among MSM residing in 20 of the 25 MSAs and Metro Divisions covered by NHBS-MSM2. Structural discrimination measures were based on a number of state level measures (7). HIV status and individual level covariates – age, income, employment status, housing status, use of non-injection drugs, and outness to others, were derived from NHBS-MSM2.

MAJOR FINDINGS

Community Sex Ratio

HIV prevalence among black, female NHBS-HET1 respondents in the sample was 3.0%. The odds ratio (OR) was 0.98 (95% CI: 0.94-1.01) for the final global, 18+ years, and 18-44 years overall sex ratio models This trend of near null values with borderline statistical significance was maintained across the full and reduced models. The trend of near null values with borderline statistical significance also continued when I explored the black race-specific sex ratios. For the final models for the black race-specific sex ratios for 0+, 18+, and 18-44 years, the ORs were 0.99 (95% CI: 0.98-1.00), 0.99 (95% CI: 0.98-1.00), and 0.99 (95% CI: 0.97-1.00), respectively. The ORs for the full and reduced models for all three black race-specific sex ratios were similar.

Perceived Discrimination against Gay and Bisexual Men

San Francisco had the lowest overall and partial perceived discrimination scores and Detroit the highest. HIV prevalence in the NHBS-MSM2 sample was 19.2%. The OR for overall perceived discrimination was 1.0 for the full, final, and reduced models with only very slight variations in the CI (95% CI: 0.96-1.03 for full model; 95% CI: 0.96-1.04 for final and reduced models). The results for the partial perceived discrimination models were similar. The ORs for the full, final, and reduced partial perceived discrimination models were 1.00 (95% CI: 0.95-1.05), 1.00 (95% CI: 0.95-1.05), and 1.01 (95% CI: 0.96-1.07), respectively. These ORs show no association between perceptions of discrimination against gay and bisexual men at the MSA or Metro Division level and HIV status among MSM at the individual level.

Structural Discrimination against Gay and Bisexual Men

While race/ethnicity was positively and significantly associated with HIV status among those employed full- or part-time, homemakers, or full-time students (OR=1.16 (95% CI: 1.07-1.27)), race/ethnicity was negatively but not significantly associated with HIV status among those unemployed, retired, disabled for work, or other (OR=0.94 (95% CI: 0.84-1.06)). For the employed/homemaker/student group, the OR for same-sex partnership discrimination was 1.10 (95% CI: 0.94-1.30). For the unemployed/retired/disabled/other group, the OR for same-sex partnership discrimination was 0.95 (95% CI: 0.84-1.29).

For non-Hispanic black (OR=1.02 (95% CI: 0.77-1.36)) and Hispanic MSM (OR=0.91 (95% CI: 0.76-1.08)), same-sex marriage prohibitions were not significantly associated with an individual man's HIV status. Among those MSM for whom race/ethnicity was defined as "other," the association between same-sex marriage prohibition and individual level HIV status was positive but not significant (OR=1.29 (95% CI: 0.93-1.78)). However, for non-Hispanic white MSM, the association was positive and significant (OR=1.24 (95% CI: 1.05-1.47)). This indicates the presence of a relationship between same-sex marriage prohibitions for non-Hispanic white MSM and but likely not for MSM of any other race/ethnicity.

CONCLUSIONS

Community Sex Ratio

Our study found no significant association between any of six age- and/or race-specific sex ratios and HIV status among black women living in 29 counties in the US. This is contrary to the theoretically grounded hypothesis that such a relationship would exist. There may be no relationship between the sex ratio and HIV status. If this is the case, further research can concentrate on other area level factors such as residential segregation that might be related to HIV status. Alternatively, the lack of relationship may be an artifact of certain limitations specific to this study. Such limitations include the relative homogeneity of the high risk areas sampled for NHBS-HET1 and the inability to control for multiple county level factors or to consider simultaneous random slopes in the modeling analyses. Considering these limitations and the previously established connection between the sex ratio and sexual partnering patterns (8, 9), further research into the roles the sex ratio and other extra-individual factors play in the occurrence of HIV may be warranted.

Perceived Discrimination against Gay and Bisexual Men

Despite prior research (10-17) indicating that a link between community level perceptions of discrimination against gay and bisexual and HIV status at the individual level should exist among MSM, our study found no significant association between community-based discrimination and HIV status. Considering potentially opposing theories regarding the discrimination-HIV link as well as our study's limitations, further research measuring the relationship between perceptions of discrimination at the community level and HIV incidence and prevalence at the individual level among different MSM populations across the US is needed. Such further research could measure perceptions of discrimination prior to the ascertainment of HIV status and focus on smaller areas such as cities or neighborhoods. It might also explore individual level perceptions of discrimination and use a more robust survey instrument.

Structural Discrimination against Gay and Bisexual Men

The association between prohibition of same-sex marriage and HIV status among non-Hispanic white men might indicate that the repeal of legal prohibitions against same-sex marriage could reduce HIV prevalence in areas where such prohibitions are currently in effect. Alternatively, areas seen as having more compassionate or permissive laws might attract MSM, thus increasing HIV prevalence. This could be causing the observed association seen or could be obscuring a true association.

Beyond the link seen in non-Hispanic white MSM, we found no significant association between different forms of structural discrimination against gay and bisexual men and HIV status. Nevertheless, given the dearth of prior research into the structural discrimination-HIV status link as well as the fact that an association was found between prohibition of same-sex marriage and HIV status among non-Hispanic white MSM, further research is warranted. Such research would address the limitations of the current study such as the relatively small number of clusters; the measurement of structural discrimination at the state rather than more local level; and the failure to account for in- and out-migration of MSM based on structural discrimination in particular areas.

REFERENCES

1. Leichliter JS, Aral SO. Black women in the United States decrease their number of recent sex partners: temporal trends from the national survey of family growth. Sex Transm Dis. 2009;36(1):1-3.
2. Leichliter JS, Chesson HW, Sternberg M, Aral SO. The concentration of sexual behaviours in the USA: a closer examination of subpopulations. Sex Transm Infect. 2010;86 Suppl 3:45-51.
3. Hallfors DD, Iritani BJ, Miller WC, Bauer DJ. Sexual and drug behavior patterns and HIV and STD racial disparities: the need for new directions. Am J Public Health. 2007;97(1):125-32.
4. Lane SD, Rubinstein RA, Keefe RH, Webster N, Cibula DA, Rosenthal A, et al. Structural violence and racial disparity in HIV transmission. J Health Care Poor Underserved. 2004;15(3):319-335.
5. Tillerson K. Explaining racial disparities in HIV/AIDS incidence among women in the U.S.: a systematic review. Stat Med. 2008;27(20):4132-43.
6. Lyles CM, Kay LS, Crepaz N, Herbst JH, Passin WF, Kim AS, et al. Best-evidence interventions: findings from a systematic review of HIV behavioral interventions for US populations at high risk, 2000-2004. Am J Public Health. 2007;97(1):133-43.
7. Human Rights Campaign. Resources: Maps of State Laws and Policies. http://www.hrc.org/resources/entry/maps-of-state-laws-policies. Accessed March 31, 2012.

8. Senn TE, Carey MP, Vanable PA, Urban MA, Sliwinski MJ. The male-to-female ratio and multiple sexual partners: multilevel analysis with patients from an STD clinic. AIDS Behav. 2008;14(4):942-8.

9. Pouget ER, Kershaw TS, Niccolai LM, Ickovics JR, Blankenship KM. Associations of sex ratios and male incarceration rates with multiple opposite-sex partners: potential social determinants of HIV/STI transmission. Public Health Rep. 2010;125 Suppl 4:70-80.

10. Herek GM. Confronting sexual stigma and prejudice: Theory and practice. J Soc Issues. 2007;63(4):905-925.

11. Herek GM, Glunt EK. Identity and community among gay and bisexual men in the AIDS era: preliminary findings from the Sacramento Men's Health Study. In: Herek GM, B. G, editors. Psychological Perspectives on Lesbian and Gay Issues: AIDS, Identity, and Community: The HIV Epidemic and Lesbians and Gay Men. Thousand Oaks, CA: Sage; 1995. p. 55-84.

12. Huebner DM, Davis MC, Nemeroff CJ, Aiken LS. The impact of internalized homophobia on HIV preventive interventions. Am J Community Psychol. 2002;30(3):327-48.

13. Meyer IH, Dean L. Internalized homophobia, intimacy, and sexual behavior among gay and bisexual men. In: Herek GM, editor. Stigma and Sexual Orientation: Understanding Prejudice Against Lesbians, Gay Men and Bisexuals. Thousand Oaks, CA: Sage; 1998.

14. Waldo CR, Kegeles SM, Hays RB. Self-acceptance of gay identity predicts decreased sexual risk behavior and increased psychological health in U.S. young gay men. 12th International AIDS Conference. Geneva, Switzerland. 1998.

15. Stokes JP, Peterson JL. Homophobia, self-esteem, and risk for HIV among African American men who have sex with men. AIDS Educ Prev. 1998;10(3):278-292.

16. Weinberg GH. Society and the healthy homosexual. New York,: St. Martin's Press; 1972.

17. Francis AM, Mialon HM. Tolerance and HIV. J Health Econ. 2010;29(2):250-67.

APPENDIX A

Association of the Community Sex Ratio with HIV Status among Black Women High Risk Areas in the United States, 2006-07

Analysis Report

INTRODUCTION

In 2008, the rate of new Human Immunodeficiency Virus (HIV) diagnoses among adults and adolescents in the United States (US) was nine times greater among blacks (73.7 diagnoses per 100,000) than among whites (8.2 per 100,000) (1). In a study of HIV prevalence conducted in 2006-07 in urban areas of 24 Metropolitan Statistical Areas (MSAs) with high Acquired Immune Deficiency Syndrome (AIDS) prevalence, the HIV prevalence ratio of whites relative to blacks was 0.5 (CI: 0.29−0.99) (2).

The black-white disparity is particularly stark among women. Despite accounting for less than 14.0% of the US female population in 2008 (3), blacks accounted for 66.7% of new HIV diagnoses among women in 2008 (1). On the other hand, whites accounted for 80.2% of the US female population but only for 18.0% of the new HIV diagnoses among women (1). Of women who contracted HIV through heterosexual contact living in 2007, 63.5% were black and 18.6% were white (1).

Despite previous research showing that the HIV disparity between black and white women is not driven solely by differences in individual level risk behaviors (4-11), most quantitative research into these disparities has to date focused on individual level factors. Nevertheless, several studies have hypothesized a link between certain community level factors and the occurrence of HIV among black women (6, 11-28). One such community level factor is the sex ratio.

Institutionalized racism, residential segregation, and other forms of black community dislocation such as imprisonment, unemployment, and higher rates of mortality have rearranged the normal patterns of dating as well as marriage and family dynamics in black communities (6, 13, 18, 19, 29, 30). During the 1960s and early 1970s in the US, a precipitous decline in the black community sex ratio preceded an increase in violent crime rates among black men (29). This imbalance continues to the present day (19, 29, 31).

An imbalanced sex ratio may lead some women to partner sexually with men whom they would not consider if the sex ratio were more balanced (18, 19, 31). While several authors have hypothesized a link between the community sex ratio and sexual risk behaviors, few have attempted to quantify this link (6, 18, 19, 26, 31-35). While some prior studies have linked the male-to-female sex ratio to rates of sexually transmitted diseases (STDs), no studies have assessed the link between an imbalanced community sex ratio and the prevalence of HIV at the individual level (31, 36-38). The purpose of this study was to examine the association between the community sex ratio and HIV status among black women in 29 US counties in 2006-07.

METHODS

Outcome of Interest: HIV Status

The outcome of interest was HIV status at the time a participant was interviewed as part of the first heterosexual iteration of the National HIV Behavioral Surveillance System (NHBS-HET1), a surveillance system implemented to monitor behaviors that place people at risk for HIV infection. NHBS-HET1 was conducted in the 25 Metropolitan Statistical Areas (MSAs) and Metropolitan (Metro) Divisions in the US with the highest AIDS prevalence in 2000 (39). In each MSA or Metro Division, the major city or epicenter of HIV and AIDS cases was the focus of data collection efforts (40). NHBS-HET1 and its sampling methods are described in greater detail elsewhere (39).

HIV status was based on a combination of self-reported status and the results of HIV tests administered during the NHBS-HET1 survey. Not all eligible respondents self-reported their HIV status as part of the survey. Others did not assent to HIV testing. In addition, among those who did assent to HIV testing, a definitive test result (i.e., positive or negative) was not always available. Considering this, preference was given to test results. Concordance between the two ways of measuring HIV status – testing and self-report – was assessed. Among black female NHBS-HET1 respondents, 98.2% who self-reported HIV status as negative tested negative and 82.8% -who self-reported as positive tested positive. These percentages were considered sufficient for our purposes. Only respondents with a known value for HIV status (positive or negative) were included in the analyses.

Exposures of Interest: Community Sex Ratios

While the community sex ratio is traditionally calculated as the simple ratio of males to females in an area of interest, six different ratios were considered for the current analyses. First, the sex ratio including males and females of all races and ethnicities was calculated for people of all ages; for people ages 18 years and older; and for people of reproductive age (18 to 44 years). Second, matched sex ratios accounting only for black men and women were calculated for the same three age groups. Full details on the ratios considered in the analyses are presented below:

- <u>Overall male:female sex ratio, 0+</u>: calculated using all men and women of all races and ages in all areas of interest.
- <u>Overall male:female sex ratio, 18+</u>: calculated using all men and women of all races, ages 18 years and older in all areas of interest.
- <u>Overall male:female sex ratio, 18-44</u>: calculated using all men and women of all races, ages 18 to 44 years in all areas of interest.
- <u>Black matched sex ratio, 0+</u>: calculated using black men and women of all ages in all areas of interest.
- <u>Black matched sex ratio, 18+</u>: calculated using black men and women ages 18 years and older in all areas of interest.
- <u>Black matched sex ratio, 18-44</u>: calculated using black men and women ages 18 to 44 years in all areas of interest. This may be the most applicable because NHBS-HET1 respondents were limited to be between ages 18 and 50.

These six ratios were calculated for 29 counties within the NHBS-HET1 MSAs and Metro Divisions. Since the majority of black female NHBS-HET1 respondents resided in the core urban areas of the sampled MSAs or Metro Divisions, analyses were limited to those counties with 10% or greater of the relevant MSA or Metro Division's black female NHBS-HET1 respondents or counties that were geographically contiguous to more than one county with 10% or more of black female NHBS-HET1 respondents (i.e., Queens County (NY)). For the Boston New England City & Town Area (NECTA), NHBS-HET1 survey sampling was based on towns rather than counties. This was taken into consideration when calculating the overall ratios for the relevant Boston communities. Three towns from the Boston NECTA (Dorchester, Lawrence, and Roxbury) were included because they represented greater than 10% of black female NHBS-HET1 respondents for the Boston NECTA. For analytic purposes, these towns were considered equivalent to counties. The full list of counties considered is presented in Table 1.

Table 1. Counties Considered for Community Sex Ratio Analyses

	County	State*	Black Female NHBS-HET1 Respondents in County
1	DeKalb	GA	42
2	Fulton	GA	295
3	Baltimore City	MD	135
4	Dorchester	MA	29
5	Lawrence	MA	8
6	Roxbury	MA	23
7	Cook	IL	330
8	Dallas	TX	608
9	Denver	CO	225
10	Wayne	MI	460
11	Broward	FL	179
12	Harris	TX	572
13	Clark	NV	165
14	Los Angeles	CA	455
15	Miami-Dade	FL	251
16	Nassau	NY	245
17	Suffolk	NY	95
18	Essex	NJ	315
19	Fairfield	CT	99
20	New Haven	CT	158
21	Orleans Parish	LA	427
22	Bronx	NY	57
23	Kings	NY	163
24	New York	NY	114
25	Queens	NY	4
26	Philadelphia	PA	220
27	San Diego	CA	79
28	San Francisco	CA	238
29	King	WA	151
30	St. Louis	MO	406
31	St. Louis City	MO	76
32	District of Columbia	DC	465

The counties listed in Table 1 represent a total sample size of 7,089. However, DeKalb County (GA), Las Vegas County (NV), and St. Louis County (MO) were eventually dropped because of zero prevalence of HIV, leaving a total sample size of 6,806. It is believed that zero prevalence in these counties was due to sampling issues rather than there being no prevalent cases of HIV in these areas.

To further focus on the core risk areas, each of the six ratios was calculated for each census tract containing at least one black female NHBS-HET1 respondent. Based on the number of respondents in each tract, a single weighted mean ratio was then calculated for each county of interest. Census tract level data were derived from the Community Survey (ACS) 2005-09 five-year sample (Tables B01001, B01001A, and B01001B) (41).

Potential Individual Level Effect Modifiers and Confounders

Data on all individual level variables were derived from NHBS-HET1. To the extent possible, individual level variables were coded so that higher numbers were associated with the theorized higher probability of positive HIV status. Details on each of the potential individual effect modifiers and confounders considered are presented below.

<u>Age</u>

Age was operationalized as an ordinal variable:

- 45 to 50 (=5).
- 40 to 44 (=4).

- 35 to 39 (=3).
- 30 to 34 (=2).
- 25 to 29 (=1).
- 18 to 24 (=0).

Income

Annual household income was stratified into the following groups based, to the extent possible, on the distribution in the sample population:

- $0 to $4,999 (=3).
- $5,000 to $9,999 (=2).
- $10,000 to $29,999 (=1).
- $30,000 or more (=0).

Education

Educational attainment was categorized as:

- None to grade 11 (=2).
- Grade 12 or GED (=1).
- Some college, associate’s or bachelor’s degree, any post graduate studies (=0).

Employment Status

Based on the relevant NHBS-HET1 question, employment status was categorized as:

- Disabled for work (=3).
- Unemployed (=2).
- Retired or other (=1).
- Employed full-time, employed part-time, homemaker, or full-time student (=0).

Housing Status

Housing status was categorized as:

- Currently homeless (=2).
- Homeless at some point in prior 12 months but currently housed (=1).
- Not homeless at any point in prior 12 months (=0).

Partner Incarceration History

NHBS-HET1 female respondents were asked whether or not their last male sex partner had ever been in jail or prison for greater than 24 hours. Since the likelihood that their last partner has spent time in jail or prison is related to both the sex ratio and HIV status, this variable was included in the analyses. It was operationalized dichotomously (yes/no).

Inclusion/Exclusion Criteria

Analyses were limited to black female NHBS-HET1 respondents. The age range for participation in NHBS-HET1 was 18-50 years. Only respondents with a known HIV status (positive or negative) were included in the analyses.

Analyses

While HIV status and potential modifier and confounder data were cross-sectional at the individual level, the exposure data (i.e., community sex ratios, isolation indices, dissimilarity indices) were cross-sectional at the county level. Since there were multilevel aspects of the combined dataset and potential clustering within counties (i.e., observations from each county presumed to be correlated), hierarchical models were developed to assess the relationship between HIV status at the individual level and the six community sex ratios while controlling for potential individual level modifiers and confounders. Table 2 presents a sample data layout for the community sex ratio analyses. The columns include county, a study ID for each participant, the outcome (HIV status) for each participant, the overall male:female sex ratio, 18-44 in each county, participant age, and participant income. In the interest of brevity, only three counties and two potential individual level effect modifiers or confounders are presented.

Table 2. Sample Data Layout for Community Sex Ratio Analyses

County	Study ID	HIV status	Overall male: female sex ratio, 18-44	Age	Income	…
Fulton County (GA)	1001	0	104.5	18	3	…
Fulton County (GA)	1002	1	104.5	23	2	…
Fulton County (GA)	1003	0	104.5	36	1	…
Fulton County (GA)	1004	0	104.5	48	0	…
Fulton County (GA)	1005	0	104.5	22	1	…
…	…	…	…	…	…	…
Cook County (IL)	7001	0	98.3	33	2	…
Cook County (IL)	7002	0	98.3	44	0	…
Cook County (IL)	7003	0	98.3	19	2	…
Cook County (IL)	7004	0	98.3	28	1	…
Cook County (IL)	7005	0	98.3	21	1	…
…	…	…	…	…	…	…
Essex County (NJ)	16001	0	102.4	41	0	…
Essex County (NJ)	16002	0	102.4	26	1	…
Essex County (NJ)	16003	0	102.4	18	3	…
Essex County (NJ)	16004	0	102.4	39	1	…
Essex County (NJ)	16005	1	102.4	28	2	…
…	…	…	…	…	…	…

NOTE: Numbers included in this table were contrived solely for the purposes of this example.

Descriptive statistics and model analyses were performed using SAS® version 9.2. Models are in the logistic form. The SAS® GENMOD procedure was used to fit generalized quasi-likelihood models. In addition, the SAS® GLIMMIX procedure was used to account for random effects resulting from the concatenation of the multiple levels. GENMOD and GLIMMIX model results were compared. Models were fit with an exchangeable correlation structure.

Correlation was assessed for different strata of the six sex ratios - highly imbalanced in favor of women (i.e., substantially more women than men); relatively balanced; highly imbalanced in favor of men (i.e., substantially more men than women). In addition, simple logistic regression models were run to assess the association between HIV status, each exposure of interest, and each individual level variable alone and controlling for all other individual level variables.

After careful consideration of the theorized causal pathway and related issues, we decided to exclude the following variables in further analyses: age (continuous), housing status past 12 months (dichotomous), alcohol use, and non-injection drug use. For each of the GENMOD and GLIMMIX models, employment status and partner incarceration history were considered in potential interaction terms with the sex ratio of interest. The starting GENMOD and GLIMMIX models for which collinearity, interaction, confounding, and precision were assessed are presented below.

The following starting GENMOD model was considered for the community sex ratio analyses (using the overall male:female sex ratio, 0+ for demonstration purposes):

$$\begin{aligned} \text{logit } P(\text{newhivstatus}=1)= \quad & \beta 0 + \beta 1(\text{sexratio0}) + \beta 2(\text{agecat}) + \beta 3(\text{newincome}) + \\ & \beta 4(\text{newschool}) + \beta 5(\text{newemploy}) + \beta 6(\text{homeless}) + \\ & \beta 7\ (\text{f\_mljail}) + \beta 8(\text{sexratio0*newemploy}) + \\ & \beta 9(\text{sexratio0*f\_mljail}) \end{aligned}$$

where: sexratio0 = overall male:female sex ratio, 0+

agecat = age (categorical)

newincome = annual household income

newschool = educational attainment

newemploy = employment status

homeless = current housing status

f_mljail = last male sex partner spent more than 24 hours in jail or prison

The starting GLIMMIX model, including a random intercept only, considered for the community sex ratio analyses (using the overall male:female sex ratio, 0+ as an example) was:

Level 1:

$$\text{logit P}(\text{newhivstatus}_{ij}=1, \mathbf{X}) = \beta_{0j} + \beta_{1j}(\text{agecat})_{ij} + \beta_{2j}(\text{newincome})_{ij} + \beta_{3j}(\text{newschool})_{ij} + \beta_{4j}(\text{newemploy})_{ij} + \beta_{5j}(\text{homeless})_{ij} + \beta_{6j}(\text{f\_mljail})_{ij}$$

Level 2:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{sexratio0})_j + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}(\text{sexratio0})_j$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21}(\text{sexratio0})_j$$

$\beta_{3j} = \gamma_{30} + \gamma_{31}(\text{sexratio0})_j$

$\beta_{4j} = \gamma_{40} + \gamma_{41}(\text{sexratio0})_j$

$\beta_{5j} = \gamma_{50} + \gamma_{51}(\text{sexratio0})_j$

$\beta_{6j} = \gamma_{60} + \gamma_{61}(\text{sexratio0})_j$

where: i = county resident *i*

j = county *j*

u_{0j} = random intercept for county *j*

All other variables are as described above.

Interaction terms omitted for sake of brevity.

Combining Levels 1 and 2

$$\begin{aligned}\text{logit } P(\text{newhivstatus}_{ij}=1, \mathbf{X}) = \; & (\gamma_{00} + \gamma_{01}(\text{sexratio0})_j + u_{0j}) + \\ & (\gamma_{10} + \gamma_{11}(\text{sexratio0})_j)(\text{agecat})_{ij} + \\ & (\gamma_{20} + \gamma_{21}(\text{sexratio0})_j)(\text{newincome})_{ij} + \\ & (\gamma_{30} + \gamma_{31}(\text{sexratio0})_j)(\text{newschool})_{ij} + \\ & (\gamma_{40} + \gamma_{41}(\text{sexratio0})_j)(\text{newemploy})_{ij} + \\ & (\gamma_{50} + \gamma_{51}(\text{sexratio0})_j)(\text{homeless})_{ij} + \\ & (\gamma_{60} + \gamma_{61}(\text{sexratio0})_j)(\text{f\_mljail})_{ij}\end{aligned}$$

For the three overall sex ratio GLIMMIX models, employment status was considered as a random slope. For the three black sex ratio GLIMMIX models, housing status was considered as a random slope. As an example of a model including a random slope, the starting GLIMMIX models for the overall sex ratio for all ages with a random intercept and a random slope for employment status is presented below:

Level 1:

$$\text{logit } P(\text{newhivstatus}_{ij}=1, \mathbf{X}) = \beta_{0j} + \beta_{1j}(\text{agecat})_{ij} + \beta_{2j}(\text{newincome})_{ij} + \beta_{3j}(\text{newschool})_{ij} + \beta_{4j}(\text{newemploy})_{ij} + \beta_{5j}(\text{homeless})_{ij} + \beta_{6j}(\text{f\_mljail})_{ij}$$

Level 2:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{sexratio0})_j + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}(\text{sexratio0})_j$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21}(\text{sexratio0})_j$$

$$\beta_{3j} = \gamma_{30} + \gamma_{31}(\text{sexratio0})_j$$

$$\beta_{4j} = \gamma_{40} + \gamma_{41}(\text{sexratio0})_j + u_{4j}$$

$$\beta_{5j} = \gamma_{50} + \gamma_{51}(\text{sexratio0})_j$$

$$\beta_{6j} = \gamma_{60} + \gamma_{61}(\text{sexratio0})_j$$

where:

i = county resident *i*

j = county *j*

u_{0j} = random intercept for county *j*

u_{4j} = random slope for employment status for county *j*

All other variables are as described above.

Interaction terms omitted for sake of brevity.

Combining Levels 1 and 2

$$
\begin{aligned}
\text{logit } P(\text{newhivstatus}_{ij}=1, \mathbf{X}) = \quad & (\gamma_{00} + \gamma_{01}(\text{sexratio0})_j + u_{0j}) + \\
& (\gamma_{10} + \gamma_{11}(\text{sexratio0})_j)(\text{agecat})_{ij} + \\
& (\gamma_{20} + \gamma_{21}(\text{sexratio0})_j)(\text{newincome})_{ij} + \\
& (\gamma_{30} + \gamma_{31}(\text{sexratio0})_j)(\text{newschool})_{ij} + \\
& (\gamma_{40} + \gamma_{41}(\text{sexratio0})_j + u_{4j})(\text{newemploy})_{ij} + \\
& (\gamma_{50} + \gamma_{51}(\text{sexratio0})_j)(\text{homeless})_{ij} + \\
& (\gamma_{60} + \gamma_{61}(\text{sexratio0})_j)(\text{f\_mljail})_{ij}
\end{aligned}
$$

For the above models, collinearity was evaluated using condition indices (cut point = 30) and variance decomposition proportions (cut point = 0.50) (42). Interaction was then assessed using the variables remaining after the previously described assessments. “Chunk” tests for groups of interaction terms were to be performed using the Wald and score tests. After the “chunk” test was to be performed, manual backward elimination was performed using the score test, dropping the most insignificant interaction terms, in order, to see if any of the remaining interaction terms were significant. Once a “full” model was established, confounding was assessed using a “10% difference rule (42).” Precision assessments based on the width of confidence intervals were also conducted.

RESULTS

This section presents, in detail, the results of the modeling analyses from collinearity assessment through the evaluation of confounding and precision. Descriptive statistics are presented in Chapter 4.

Collinearity Assessment

Collinearity was evaluated separately for each of the six models. Once this assessment was performed, all interaction terms were dropped from both GENMOD and both GLIMMIX models for the three overall sex ratios and the sexually active and reproductive age black matched sex ratios. For the black matched sex ratio including all ages, the employment status interaction term remained.

Interaction Assessment

Next, separate GENMOD and GLIMMIX modeling procedures were followed for each sex ratio of interest. Interaction was evaluated only for the black matched sex ratio including all ages. Since only one interaction term remained in this model, "chunk" tests for groups of interaction terms were not performed. Instead, manual backward elimination was performed using the score test. As a result of performing backward, the employment status interaction term was not found to be significant and was therefore removed from both the GENMOD and GLIMMIX models for the black matched sex ratio including all ages.

Confounding and Precision Assessment

A series of GENMOD and GLIMMIX models including all possible combinations of covariates (i.e., all variables other than the exposure of interest) were run. GENMOD models were run without ‘estimate’ statements. GLIMMIX models were run with no ‘at’ suboption on and used only a random intercept. Tables 3-14 present odds ratios (ORs) for a one-unit change in the sex ratio of interest based on six sets of GENMOD and six sets of GLIMMIX models.

The tables are presented in pairs. While the first table in each pair shows ORs calculated for the sex ratio of interest based on the relevant GENMOD model, the second table shows ORs calculated based on the relevant GLIMMIX model. For example, Tables 1-2 show the GENMOD and GLIMMIX ORs for the overall sex ratio including all men and women of all races and ethnicities and all ages. Six pairs of GENMOD and GLIMMIX ORs were calculated.

The first row of each table shows the “full” model (i.e., all variables included). The last row of each table presents the “reduced” model (i.e., only the exposure of interest included). The intervening rows depict models based on all possible combinations of covariates.

The first column of each table shows the model number. The second column of each table presents the exposure of interest. The next six columns show the covariates included in each particular model. Next are the OR for the exposure and its corresponding 95% confidence interval (CI).

Table 3. GENMOD Model Odds Ratios for Overall Male:Female Sex Ratio, 0+

model #	exposure	model covariates						OR	95% CI, lower	95% CI, upper
AGE1	sexratio0	agecat	newincome	newschool	newemploy	homeless	f_mljail	0.972	0.933	1.012
AGE2	sexratio0	agecat	newincome	newschool	newemploy	homeless		0.969	0.927	1.014
AGE3	sexratio0	agecat	newincome	newschool	newemploy		f_mljail	0.971	0.930	1.014
AGE4	sexratio0	agecat	newincome	newschool		homeless	f_mljail	0.978	0.943	1.015
AGE5	sexratio0	agecat	newincome		newemploy	homeless	f_mljail	0.970	0.932	1.009
AGE6	sexratio0	agecat		newschool	newemploy	homeless	f_mljail	0.972	0.932	1.012
AGE7	sexratio0		newincome	newschool	newemploy	homeless	f_mljail	0.967	0.924	1.013
AGE8	sexratio0			newschool	newemploy	homeless	f_mljail	0.967	0.923	1.013
AGE9	sexratio0	agecat			newemploy	homeless	f_mljail	0.969	0.931	1.010
AGE10	sexratio0	agecat	newincome			homeless	f_mljail	0.976	0.941	1.011
AGE11	sexratio0	agecat	newincome	newschool			f_mljail	0.977	0.938	1.018
AGE12	sexratio0	agecat	newincome	newschool	newemploy			0.968	0.923	1.015
AGE13	sexratio0		newincome		newemploy	homeless	f_mljail	0.966	0.923	1.010
AGE14	sexratio0		newincome	newschool		homeless	f_mljail	0.975	0.939	1.012
AGE15	sexratio0		newincome	newschool	newemploy		f_mljail	0.966	0.917	1.017
AGE16	sexratio0		newincome	newschool	newemploy	homeless		0.964	0.917	1.014
AGE17	sexratio0	agecat		newschool		homeless	f_mljail	0.980	0.945	1.016
AGE18	sexratio0	agecat		newschool	newemploy		f_mljail	0.971	0.929	1.015
AGE19	sexratio0	agecat		newschool	newemploy	homeless		0.969	0.927	1.014
AGE20	sexratio0	agecat	newincome		newemploy		f_mljail	0.969	0.928	1.012
AGE21	sexratio0	agecat	newincome		newemploy	homeless		0.968	0.926	1.012
AGE22	sexratio0	agecat	newincome	newschool		homeless		0.976	0.937	1.016

AGE23	sexratio0				newemploy	homeless	f_mljail	0.965	0.922	1.011
AGE24	sexratio0	agecat				homeless	f_mljail	0.977	0.944	1.012
AGE25	sexratio0	agecat	newincome				f_mljail	0.974	0.935	1.015
AGE26	sexratio0	agecat	newincome	newschool				0.974	0.931	1.019
AGE27	sexratio0			newschool		homeless	f_mljail	0.977	0.942	1.013
AGE28	sexratio0			newschool	newemploy		f_mljail	0.966	0.916	1.018
AGE29	sexratio0			newschool	newemploy	homeless		0.965	0.917	1.015
AGE30	sexratio0		newincome			homeless	f_mljail	0.973	0.939	1.008
AGE31	sexratio0		newincome		newemploy		f_mljail	0.964	0.915	1.015
AGE32	sexratio0		newincome		newemploy	homeless		0.963	0.916	1.012
AGE33	sexratio0		newincome	newschool			f_mljail	0.970	0.924	1.019
AGE34	sexratio0		newincome	newschool		homeless		0.973	0.933	1.014
AGE35	sexratio0		newincome	newschool	newemploy			0.962	0.909	1.018
AGE36	sexratio0	agecat			newemploy		f_mljail	0.969	0.928	1.012
AGE37	sexratio0	agecat			newemploy	homeless		0.968	0.926	1.012
AGE38	sexratio0	agecat		newschool			f_mljail	0.980	0.941	1.020
AGE39	sexratio0	agecat		newschool		homeless		0.978	0.940	1.017
AGE40	sexratio0	agecat		newschool	newemploy			0.968	0.923	1.016
AGE41	sexratio0	agecat	newincome			homeless		0.974	0.935	1.014
AGE42	sexratio0	agecat	newincome		newemploy			0.967	0.922	1.014
AGE43	sexratio0	agecat	newincome					0.972	0.929	1.017
AGE44	sexratio0		newincome	newschool				0.966	0.915	1.021
AGE45	sexratio0			newschool	newemploy			0.962	0.909	1.019
AGE46	sexratio0				newemploy	homeless		0.963	0.916	1.013
AGE47	sexratio0					homeless	f_mljail	0.975	0.942	1.008
AGE48	sexratio0	agecat		newschool				0.977	0.934	1.013
AGE49	sexratio0	agecat			newemploy			0.967	0.922	1.014

AGE50	sexratio0	agecat				homeless		0.977	0.940	1.015
AGE51	sexratio0	agecat					f_mljail	0.977	0.938	1.018
AGE52	sexratio0		newincome		newemploy			0.961	0.908	1.016
AGE53	sexratio0		newincome			homeless		0.971	0.933	1.010
AGE54	sexratio0		newincome				f_mljail	0.966	0.921	1.014
AGE55	sexratio0			newschool		homeless		0.976	0.937	1.015
AGE56	sexratio0			newschool			f_mljail	0.974	0.927	1.023
AGE57	sexratio0				newemploy		f_mljail	0.964	0.914	1.016
AGE58	sexratio0	agecat						0.975	0.932	1.020
AGE59	sexratio0		newincome					0.963	0.913	1.016
AGE60	sexratio0			newschool				0.971	0.919	1.025
AGE61	sexratio0				newemploy			0.961	0.908	1.017
AGE62	sexratio0					homeless		0.975	0.940	1.011
AGE63	sexratio0						f_mljail	0.970	0.925	1.017
AGE64	sexratio0							0.968	0.919	1.020

Table 4. GLIMMIX Model Odds Ratios for Overall Male:Female Sex Ratio, 0+

model #	exposure	model covariates						OR	95% CI, lower	95% CI, upper
AGL1	sexratio0	agecat	newincome	newschool	newemploy	homeless	f_mljail	0.977	0.945	1.009
AGL2	sexratio0	agecat	newincome	newschool	newemploy	homeless		0.977	0.945	1.011
AGL3	sexratio0	agecat	newincome	newschool	newemploy		f_mljail	0.977	0.945	1.011
AGL4	sexratio0	agecat	newincome	newschool		homeless	f_mljail	0.978	0.946	1.012
AGL5	sexratio0	agecat	newincome		newemploy	homeless	f_mljail	0.975	0.944	1.007
AGL6	sexratio0	agecat		newschool	newemploy	homeless	f_mljail	0.976	0.945	1.009
AGL7	sexratio0		newincome	newschool	newemploy	homeless	f_mljail	0.976	0.944	1.010
AGL8	sexratio0			newschool	newemploy	homeless	f_mljail	0.977	0.943	1.011
AGL9	sexratio0	agecat			newemploy	homeless	f_mljail	0.974	0.942	1.007
AGL10	sexratio0	agecat	newincome			homeless	f_mljail	0.976	0.944	1.010
AGL11	sexratio0	agecat	newincome	newschool			f_mljail	0.979	0.945	1.014
AGL12	sexratio0	agecat	newincome	newschool	newemploy			0.978	0.944	1.012
AGL13	sexratio0		newincome		newemploy	homeless	f_mljail	0.975	0.943	1.009
AGL14	sexratio0		newincome	newschool		homeless	f_mljail	0.978	0.943	1.015
AGL15	sexratio0		newincome	newschool	newemploy		f_mljail	0.977	0.943	1.013
AGL16	sexratio0		newincome	newschool	newemploy	homeless		0.977	0.942	1.012
AGL17	sexratio0	agecat		newschool		homeless	f_mljail	0.978	0.945	1.012
AGL18	sexratio0	agecat		newschool	newemploy		f_mljail	0.977	0.944	1.011
AGL19	sexratio0	agecat		newschool	newemploy	homeless		0.977	0.944	1.011
AGL20	sexratio0	agecat	newincome		newemploy		f_mljail	0.975	0.943	1.009
AGL21	sexratio0	agecat	newincome		newemploy	homeless		0.976	0.943	1.010
AGL22	sexratio0	agecat	newincome	newschool		homeless		0.979	0.945	1.014

AGL23	sexratio0				newemploy	homeless	f_mljail	0.975	0.942	1.009
AGL24	sexratio0	agecat				homeless	f_mljail	0.975	0.942	1.009
AGL25	sexratio0	agecat	newincome				f_mljail	0.977	0.943	1.012
AGL26	sexratio0	agecat	newincome	newschool				0.979	0.944	1.016
AGL27	sexratio0			newschool		homeless	f_mljail	0.978	0.943	1.014
AGL28	sexratio0			newschool	newemploy		f_mljail	0.977	0.943	1.013
AGL29	sexratio0			newschool	newemploy	homeless		0.977	0.942	1.013
AGL30	sexratio0		newincome			homeless	f_mljail	0.976	0.942	1.012
AGL31	sexratio0		newincome		newemploy		f_mljail	0.976	0.942	1.012
AGL32	sexratio0		newincome		newemploy	homeless		0.975	0.941	1.011
AGL33	sexratio0		newincome	newschool			f_mljail	0.979	0.942	1.018
AGL34	sexratio0		newincome	newschool		homeless		0.978	0.942	1.016
AGL35	sexratio0		newincome	newschool	newemploy			0.977	0.941	1.014
AGL36	sexratio0	agecat			newemploy		f_mljail	0.975	0.942	1.009
AGL37	sexratio0	agecat			newemploy	homeless		0.975	0.941	1.009
AGL38	sexratio0	agecat		newschool			f_mljail	0.978	0.944	1.014
AGL39	sexratio0	agecat		newschool		homeless		0.978	0.944	1.014
AGL40	sexratio0	agecat		newschool	newemploy			0.977	0.943	1.012
AGL41	sexratio0	agecat	newincome			homeless		0.977	0.943	1.012
AGL42	sexratio0	agecat	newincome		newemploy			0.976	0.942	1.011
AGL43	sexratio0	agecat	newincome					0.977	0.942	1.014
AGL44	sexratio0		newincome	newschool				0.979	0.940	1.019
AGL45	sexratio0			newschool	newemploy			0.977	0.941	1.015
AGL46	sexratio0				newemploy	homeless		0.975	1.064	1.011
AGL47	sexratio0					homeless	f_mljail	0.975	0.940	1.012
AGL48	sexratio0	agecat		newschool				0.979	0.943	1.015
AGL49	sexratio0	agecat			newemploy			0.975	0.941	1.010

AGL50	sexratio0	agecat				homeless		0.975	0.941	1.011
AGL51	sexratio0	agecat					f_mljail	0.975	0.941	1.011
AGL52	sexratio0		newincome		newemploy			0.976	0.940	1.013
AGL53	sexratio0		newincome			homeless		0.976	0.940	1.015
AGL54	sexratio0		newincome				f_mljail	0.977	0.940	1.016
AGL55	sexratio0			newschool		homeless		0.978	0.941	1.016
AGL56	sexratio0			newschool			f_mljail	0.979	0.941	1.018
AGL57	sexratio0				newemploy		f_mljail	0.976	0.941	1.012
AGL58	sexratio0	agecat						0.975	0.940	1.013
AGL59	sexratio0		newincome					0.977	0.938	1.018
AGL60	sexratio0			newschool				0.978	0.939	1.019
AGL61	sexratio0				newemploy			0.975	0.939	1.013
AGL62	sexratio0					homeless		0.975	0.938	1.013
AGL63	sexratio0						f_mljail	0.976	0.938	1.016
AGL64	sexratio0							0.975	0.936	1.017

Table 5. GENMOD Model Odds Ratios for Overall Male:Female Sex Ratio, 18+

model #	exposure	model covariates						OR	95% CI, lower	95% CI, upper
BGE1	sexratio18	agecat	newincome	newschool	newemploy	homeless	f_mljail	0.973	0.941	1.006
BGE2	sexratio18	agecat	newincome	newschool	newemploy	homeless		0.971	0.936	1.007
BGE3	sexratio18	agecat	newincome	newschool	newemploy		f_mljail	0.972	0.939	1.007
BGE4	sexratio18	agecat	newincome	newschool		homeless	f_mljail	0.980	0.950	1.011
BGE5	sexratio18	agecat	newincome		newemploy	homeless	f_mljail	0.972	0.940	1.004
BGE6	sexratio18	agecat		newschool	newemploy	homeless	f_mljail	0.973	0.940	1.006
BGE7	sexratio18		newincome	newschool	newemploy	homeless	f_mljail	0.969	0.932	1.006
BGE8	sexratio18			newschool	newemploy	homeless	f_mljail	0.968	0.932	1.007
BGE9	sexratio18	agecat			newemploy	homeless	f_mljail	0.971	0.940	1.004
BGE10	sexratio18	agecat	newincome			homeless	f_mljail	0.978	0.949	1.008
BGE11	sexratio18	agecat	newincome	newschool			f_mljail	0.979	0.946	1.013
BGE12	sexratio18	agecat	newincome	newschool	newemploy			0.970	0.934	1.008
BGE13	sexratio18		newincome		newemploy	homeless	f_mljail	0.967	0.932	1.004
BGE14	sexratio18		newincome	newschool		homeless	f_mljail	0.976	0.945	1.009
BGE15	sexratio18		newincome	newschool	newemploy		f_mljail	0.967	0.927	1.009
BGE16	sexratio18		newincome	newschool	newemploy	homeless		0.965	0.926	1.006
BGE17	sexratio18	agecat		newschool		homeless	f_mljail	0.981	0.951	1.012
BGE18	sexratio18	agecat		newschool	newemploy		f_mljail	0.972	0.938	1.008
BGE19	sexratio18	agecat		newschool	newemploy	homeless		0.971	0.936	1.007
BGE20	sexratio18	agecat	newincome		newemploy		f_mljail	0.971	0.938	1.005
BGE21	sexratio18	agecat	newincome		newemploy	homeless		0.970	0.935	1.005
BGE22	sexratio18	agecat	newincome	newschool		homeless		0.977	0.949	1.007

BGE23	sexratio18				newemploy	homeless	f_mljail	0.967	0.931	1.004
BGE24	sexratio18	agecat				homeless	f_mljail	0.980	0.951	1.010
BGE25	sexratio18	agecat	newincome				f_mljail	0.977	0.944	1.010
BGE26	sexratio18	agecat	newincome	newschool				0.976	0.940	1.013
BGE27	sexratio18			newschool		homeless	f_mljail	0.978	0.947	1.010
BGE28	sexratio18			newschool	newemploy		f_mljail	0.967	0.926	1.010
BGE29	sexratio18			newschool	newemploy	homeless		0.966	0.926	1.007
BGE30	sexratio18		newincome			homeless	f_mljail	0.974	0.945	1.005
BGE31	sexratio18		newincome		newemploy		f_mljail	0.965	0.926	1.006
BGE32	sexratio18		newincome		newemploy	homeless		0.965	0.926	1.005
BGE33	sexratio18		newincome	newschool			f_mljail	0.971	0.932	1.012
BGE34	sexratio18		newincome	newschool		homeless		0.973	0.939	1.009
BGE35	sexratio18		newincome	newschool	newemploy			0.963	0.920	1.009
BGE36	sexratio18	agecat			newemploy		f_mljail	0.971	0.937	1.006
BGE37	sexratio18	agecat			newemploy	homeless		0.970	0.935	1.006
BGE38	sexratio18	agecat		newschool			f_mljail	0.981	0.948	1.015
BGE39	sexratio18	agecat		newschool		homeless		0.979	0.947	1.013
BGE40	sexratio18	agecat		newschool	newemploy			0.970	0.933	1.008
BGE41	sexratio18	agecat	newincome			homeless		0.976	0.944	1.009
BGE42	sexratio18	agecat	newincome		newemploy			0.969	0.933	1.006
BGE43	sexratio18	agecat	newincome					0.974	0.939	1.011
BGE44	sexratio18		newincome	newschool				0.968	0.925	1.012
BGE45	sexratio18			newschool	newemploy			0.964	0.920	1.010
BGE46	sexratio18				newemploy	homeless		0.965	0.926	1.005
BGE47	sexratio18					homeless	f_mljail	0.977	1.055	1.007
BGE48	sexratio18	agecat		newschool				0.979	0.942	1.016
BGE49	sexratio18	agecat			newemploy			0.969	0.932	1.007

BGE50	sexratio18	agecat				homeless		0.979	0.948	1.011
BGE51	sexratio18	agecat					f_mljail	0.980	0.947	1.014
BGE52	sexratio18		newincome		newemploy			0.962	0.920	1.007
BGE53	sexratio18		newincome			homeless		0.972	0.940	1.005
BGE54	sexratio18		newincome				f_mljail	0.969	0.931	1.008
BGE55	sexratio18			newschool		homeless		0.976	0.943	1.010
BGE56	sexratio18			newschool			f_mljail	0.974	0.935	1.015
BGE57	sexratio18				newemploy		f_mljail	0.965	0.925	1.007
BGE58	sexratio18	agecat						0.978	0.942	1.015
BGE59	sexratio18		newincome					0.965	0.924	1.008
BGE60	sexratio18			newschool				0.971	0.928	1.016
BGE61	sexratio18				newemploy			0.962	0.919	1.008
BGE62	sexratio18					homeless		0.976	0.946	1.007
BGE63	sexratio18						f_mljail	0.972	0.934	1.011
BGE64	sexratio18							0.970	0.929	1.012

Table 6. GLIMMIX Model Odds Ratios for Overall Male:Female Sex Ratio, 18+

model #	exposure	model covariates						OR	95% CI, lower	95% CI, upper
BGL1	sexratio18	agecat	newincome	newschool	newemploy	homeless	f_mljail	0.978	0.951	1.006
BGL2	sexratio18	agecat	newincome	newschool	newemploy	homeless		0.978	0.950	1.008
BGL3	sexratio18	agecat	newincome	newschool	newemploy		f_mljail	0.978	0.950	1.007
BGL4	sexratio18	agecat	newincome	newschool		homeless	f_mljail	0.980	0.951	1.009
BGL5	sexratio18	agecat	newincome		newemploy	homeless	f_mljail	0.977	0.949	1.005
BGL6	sexratio18	agecat		newschool	newemploy	homeless	f_mljail	0.978	0.950	1.007
BGL7	sexratio18		newincome	newschool	newemploy	homeless	f_mljail	0.977	0.948	1.007
BGL8	sexratio18			newschool	newemploy	homeless	f_mljail	0.978	0.948	1.008
BGL9	sexratio18	agecat			newemploy	homeless	f_mljail	0.976	0.948	1.005
BGL10	sexratio18	agecat	newincome			homeless	f_mljail	0.978	0.950	1.007
BGL11	sexratio18	agecat	newincome	newschool			f_mljail	0.980	0.951	1.011
BGL12	sexratio18	agecat	newincome	newschool	newemploy			0.979	0.949	1.009
BGL13	sexratio18		newincome		newemploy	homeless	f_mljail	0.976	0.948	1.006
BGL14	sexratio18		newincome	newschool		homeless	f_mljail	0.979	0.948	1.011
BGL15	sexratio18		newincome	newschool	newemploy		f_mljail	0.978	0.948	1.009
BGL16	sexratio18		newincome	newschool	newemploy	homeless		0.977	0.947	1.009
BGL17	sexratio18	agecat		newschool		homeless	f_mljail	0.979	0.951	1.009
BGL18	sexratio18	agecat		newschool	newemploy		f_mljail	0.978	0.950	1.008
BGL19	sexratio18	agecat		newschool	newemploy	homeless		0.978	0.949	1.008
BGL20	sexratio18	agecat	newincome		newemploy		f_mljail	0.977	0.949	1.006
BGL21	sexratio18	agecat	newincome		newemploy	homeless		0.977	0.948	1.007
BGL22	sexratio18	agecat	newincome	newschool		homeless		0.980	0.950	1.011

BGL23	sexratio18				newemploy	homeless	f_mljail	0.976	0.947	1.006
BGL24	sexratio18	agecat				homeless	f_mljail	0.977	0.948	1.006
BGL25	sexratio18	agecat	newincome				f_mljail	0.979	0.949	1.009
BGL26	sexratio18	agecat	newincome	newschool				0.980	0.950	1.012
BGL27	sexratio18			newschool		homeless	f_mljail	0.979	0.948	1.011
BGL28	sexratio18			newschool	newemploy		f_mljail	0.978	0.948	1.010
BGL29	sexratio18			newschool	newemploy	homeless		0.977	0.946	1.009
BGL30	sexratio18		newincome			homeless	f_mljail	0.978	0.947	1.010
BGL31	sexratio18		newincome		newemploy		f_mljail	0.977	0.947	1.008
BGL32	sexratio18		newincome		newemploy	homeless		0.976	0.946	1.007
BGL33	sexratio18		newincome	newschool			f_mljail	0.980	0.947	1.014
BGL34	sexratio18		newincome	newschool		homeless		0.979	0.946	1.013
BGL35	sexratio18		newincome	newschool	newemploy			0.978	0.946	1.010
BGL36	sexratio18	agecat			newemploy		f_mljail	0.976	0.948	1.006
BGL37	sexratio18	agecat			newemploy	homeless		0.976	0.947	1.006
BGL38	sexratio18	agecat		newschool			f_mljail	0.980	0.950	1.011
BGL39	sexratio18	agecat		newschool		homeless		0.979	0.949	1.011
BGL40	sexratio18	agecat		newschool	newemploy			0.978	0.948	1.009
BGL41	sexratio18	agecat	newincome			homeless		0.978	0.949	1.009
BGL42	sexratio18	agecat	newincome		newemploy			0.977	0.948	1.007
BGL43	sexratio18	agecat	newincome					0.979	0.948	1.010
BGL44	sexratio18		newincome	newschool				0.980	0.945	1.015
BGL45	sexratio18			newschool	newemploy			0.978	0.946	1.011
BGL46	sexratio18				newemploy	homeless		0.976	0.945	1.008
BGL47	sexratio18					homeless	f_mljail	0.977	0.946	1.009
BGL48	sexratio18	agecat		newschool				0.980	0.949	1.012
BGL49	sexratio18	agecat			newemploy			0.976	0.946	1.007

BGL50	sexratio18	agecat				homeless		0.977	0.947	1.008
BGL51	sexratio18	agecat					f_mljail	0.978	0.947	1.009
BGL52	sexratio18		newincome		newemploy			0.977	0.945	1.009
BGL53	sexratio18		newincome			homeless		0.977	0.945	1.011
BGL54	sexratio18		newincome				f_mljail	0.978	0.945	1.013
BGL55	sexratio18			newschool		homeless		0.979	0.946	1.012
BGL56	sexratio18			newschool			f_mljail	0.980	0.946	1.015
BGL57	sexratio18				newemploy		f_mljail	0.977	0.946	1.008
BGL58	sexratio18	agecat						0.977	0.946	1.010
BGL59	sexratio18		newincome					0.978	0.943	1.013
BGL60	sexratio18			newschool				0.979	0.944	1.015
BGL61	sexratio18				newemploy			0.976	0.944	1.009
BGL62	sexratio18					homeless		0.976	0.943	1.010
BGL63	sexratio18						f_mljail	0.977	0.944	1.012
BGL64	sexratio18							0.977	0.942	1.013

Table 7. GENMOD Model Odds Ratios for Overall Male:Female Sex Ratio, 18-44

model #	exposure	model covariates						OR	95% CI, lower	95% CI, upper
CGE1	sexratio1844	agecat	newincome	newschool	newemploy	homeless	f_mljail	0.972	0.943	1.002
CGE2	sexratio1844	agecat	newincome	newschool	newemploy	homeless		0.970	0.939	1.002
CGE3	sexratio1844	agecat	newincome	newschool	newemploy		f_mljail	0.971	0.942	1.002
CGE4	sexratio1844	agecat	newincome	newschool		homeless	f_mljail	0.978	0.949	1.009
CGE5	sexratio1844	agecat	newincome		newemploy	homeless	f_mljail	0.971	0.943	1.001
CGE6	sexratio1844	agecat		newschool	newemploy	homeless	f_mljail	0.972	0.943	1.002
CGE7	sexratio1844		newincome	newschool	newemploy	homeless	f_mljail	0.968	0.937	1.001
CGE8	sexratio1844			newschool	newemploy	homeless	f_mljail	0.968	0.937	1.001
CGE9	sexratio1844	agecat			newemploy	homeless	f_mljail	0.971	0.942	1.001
CGE10	sexratio1844	agecat	newincome			homeless	f_mljail	0.977	0.948	1.007
CGE11	sexratio1844	agecat	newincome	newschool			f_mljail	0.977	0.945	1.009
CGE12	sexratio1844	agecat	newincome	newschool	newemploy			0.969	0.937	1.002
CGE13	sexratio1844		newincome		newemploy	homeless	f_mljail	0.968	0.937	0.999
CGE14	sexratio1844		newincome	newschool		homeless	f_mljail	0.975	0.946	1.006
CGE15	sexratio1844		newincome	newschool	newemploy		f_mljail	0.966	0.932	1.001
CGE16	sexratio1844		newincome	newschool	newemploy	homeless		0.966	0.933	1.000
CGE17	sexratio1844	agecat		newschool		homeless	f_mljail	0.979	0.949	1.010
CGE18	sexratio1844	agecat		newschool	newemploy		f_mljail	0.971	0.941	1.003
CGE19	sexratio1844	agecat		newschool	newemploy	homeless		0.970	0.939	1.003
CGE20	sexratio1844	agecat	newincome		newemploy		f_mljail	0.970	0.941	1.001
CGE21	sexratio1844	agecat	newincome		newemploy	homeless		0.969	0.939	1.001
CGE22	sexratio1844	agecat	newincome	newschool		homeless		0.976	0.944	1.008

CGE23	sexratio1844				newemploy	homeless	f_mljail	0.967	0.936	1.000
CGE24	sexratio1844	agecat				homeless	f_mljail	0.979	0.949	1.009
CGE25	sexratio1844	agecat	newincome				f_mljail	0.976	0.944	1.008
CGE26	sexratio1844	agecat	newincome	newschool				0.973	0.940	1.008
CGE27	sexratio1844			newschool		homeless	f_mljail	0.976	0.947	1.007
CGE28	sexratio1844			newschool	newemploy		f_mljail	0.966	0.931	1.002
CGE29	sexratio1844			newschool	newemploy	homeless		0.966	0.932	1.001
CGE30	sexratio1844		newincome			homeless	f_mljail	0.974	0.946	1.003
CGE31	sexratio1844		newincome		newemploy		f_mljail	0.965	0.932	1.000
CGE32	sexratio1844		newincome		newemploy	homeless		0.965	0.933	0.999
CGE33	sexratio1844		newincome	newschool			f_mljail	0.969	0.935	1.004
CGE34	sexratio1844		newincome	newschool		homeless		0.972	0.941	1.005
CGE35	sexratio1844		newincome	newschool	newemploy			0.963	0.928	1.000
CGE36	sexratio1844	agecat			newemploy		f_mljail	0.970	0.939	1.001
CGE37	sexratio1844	agecat			newemploy	homeless		0.969	0.938	1.002
CGE38	sexratio1844	agecat		newschool			f_mljail	0.978	0.945	1.012
CGE39	sexratio1844	agecat		newschool		homeless		0.977	0.945	1.010
CGE40	sexratio1844	agecat		newschool	newemploy			0.969	0.936	1.002
CGE41	sexratio1844	agecat	newincome			homeless		0.975	0.944	1.007
CGE42	sexratio1844	agecat	newincome		newemploy			0.968	0.937	1.000
CGE43	sexratio1844	agecat	newincome					0.972	0.939	1.007
CGE44	sexratio1844		newincome	newschool				0.965	0.929	1.002
CGE45	sexratio1844			newschool	newemploy			0.963	0.927	1.001
CGE46	sexratio1844				newemploy	homeless		0.966	0.932	1.000
CGE47	sexratio1844					homeless	f_mljail	0.976	0.948	1.005
CGE48	sexratio1844	agecat		newschool				0.975	0.940	1.011
CGE49	sexratio1844	agecat			newemploy			0.968	0.935	1.001

CGE50	sexratio1844	agecat				homeless		0.977	0.946	1.010
CGE51	sexratio1844	agecat					f_mljail	0.977	0.944	1.012
CGE52	sexratio1844		newincome		newemploy			0.963	0.928	0.999
CGE53	sexratio1844		newincome			homeless		0.972	0.942	1.002
CGE54	sexratio1844		newincome				f_mljail	0.967	0.935	1.001
CGE55	sexratio1844			newschool		homeless		0.974	0.943	1.007
CGE56	sexratio1844			newschool			f_mljail	0.970	0.935	1.007
CGE57	sexratio1844				newemploy		f_mljail	0.965	0.931	1.000
CGE58	sexratio1844	agecat						0.975	0.939	1.011
CGE59	sexratio1844		newincome					0.964	0.929	1.000
CGE60	sexratio1844			newschool				0.967	0.929	1.006
CGE61	sexratio1844				newemploy			0.962	0.927	0.999
CGE62	sexratio1844					homeless		0.975	0.946	1.005
CGE63	sexratio1844						f_mljail	0.969	0.935	1.004
CGE64	sexratio1844							0.966	0.930	1.004

Table 8. GLIMMIX Model Odds Ratios for Overall Male:Female Sex Ratio, 18-44

model #	exposure	model covariates						OR	95% CI, lower	95% CI, upper
CGL1	sexratio1844	agecat	newincome	newschool	newemploy	homeless	f_mljail	0.972	0.950	0.995
CGL2	sexratio1844	agecat	newincome	newschool	newemploy	homeless		0.970	0.948	0.993
CGL3	sexratio1844	agecat	newincome	newschool	newemploy		f_mljail	0.971	0.949	0.994
CGL4	sexratio1844	agecat	newincome	newschool		homeless	f_mljail	0.978	0.954	1.004
CGL5	sexratio1844	agecat	newincome		newemploy	homeless	f_mljail	0.976	0.949	0.994
CGL6	sexratio1844	agecat		newschool	newemploy	homeless	f_mljail	0.978	0.950	0.995
CGL7	sexratio1844		newincome	newschool	newemploy	homeless	f_mljail	0.978	0.944	0.993
CGL8	sexratio1844			newschool	newemploy	homeless	f_mljail	0.978	0.944	0.993
CGL9	sexratio1844	agecat			newemploy	homeless	f_mljail	0.976	0.949	0.994
CGL10	sexratio1844	agecat	newincome			homeless	f_mljail	0.977	0.953	1.003
CGL11	sexratio1844	agecat	newincome	newschool			f_mljail	0.978	0.952	1.003
CGL12	sexratio1844	agecat	newincome	newschool	newemploy			0.978	0.946	0.992
CGL13	sexratio1844		newincome		newemploy	homeless	f_mljail	0.976	0.944	0.992
CGL14	sexratio1844		newincome	newschool		homeless	f_mljail	0.978	0.947	1.005
CGL15	sexratio1844		newincome	newschool	newemploy		f_mljail	0.978	0.942	0.991
CGL16	sexratio1844		newincome	newschool	newemploy	homeless		0.977	0.549	0.991
CGL17	sexratio1844	agecat		newschool		homeless	f_mljail	0.978	0.955	1.005
CGL18	sexratio1844	agecat		newschool	newemploy		f_mljail	0.978	0.949	0.994
CGL19	sexratio1844	agecat		newschool	newemploy	homeless		0.978	0.948	0.993
CGL20	sexratio1844	agecat	newincome		newemploy		f_mljail	0.976	0.948	0.993
CGL21	sexratio1844	agecat	newincome		newemploy	homeless		0.977	0.947	0.992
CGL22	sexratio1844	agecat	newincome	newschool		homeless		0.979	0.951	1.001

CGL23	sexratio1844				newemploy	homeless	f_mljail	0.976	0.943	0.992
CGL24	sexratio1844	agecat				homeless	f_mljail	0.976	0.954	1.005
CGL25	sexratio1844	agecat	newincome				f_mljail	0.976	0.950	1.002
CGL26	sexratio1844	agecat	newincome	newschool				0.978	0.948	0.999
CGL27	sexratio1844			newschool		homeless	f_mljail	0.978	0.947	1.007
CGL28	sexratio1844			newschool	newemploy		f_mljail	0.978	0.931	1.002
CGL29	sexratio1844			newschool	newemploy	homeless		0.977	0.942	0.991
CGL30	sexratio1844		newincome			homeless	f_mljail	0.976	0.945	1.004
CGL31	sexratio1844		newincome		newemploy		f_mljail	0.976	0.941	0.990
CGL32	sexratio1844		newincome		newemploy	homeless		0.976	0.941	0.990
CGL33	sexratio1844		newincome	newschool			f_mljail	0.977	0.939	0.999
CGL34	sexratio1844		newincome	newschool		homeless		0.977	0.943	1.002
CGL35	sexratio1844		newincome	newschool	newemploy			0.977	0.939	0.998
CGL36	sexratio1844	agecat			newemploy		f_mljail	0.976	0.947	0.993
CGL37	sexratio1844	agecat			newemploy	homeless		0.976	0.947	0.992
CGL38	sexratio1844	agecat		newschool			f_mljail	0.978	0.953	1.004
CGL39	sexratio1844	agecat		newschool		homeless		0.979	0.952	1.003
CGL40	sexratio1844	agecat		newschool	newemploy			0.978	0.947	0.992
CGL41	sexratio1844	agecat	newincome			homeless		0.977	0.950	1.001
CGL42	sexratio1844	agecat	newincome		newemploy			0.977	0.945	0.991
CGL43	sexratio1844	agecat	newincome					0.977	0.947	0.999
CGL44	sexratio1844		newincome	newschool				0.977	0.935	0.996
CGL45	sexratio1844			newschool	newemploy			0.977	0.939	0.988
CGL46	sexratio1844				newemploy	homeless		0.976	0.941	0.990
CGL47	sexratio1844					homeless	f_mljail	0.975	0.947	1.006
CGL48	sexratio1844	agecat		newschool				0.978	0.949	1.001
CGL49	sexratio1844	agecat			newemploy			0.976	0.945	0.991

CGL50	sexratio1844	agecat				homeless		0.976	0.952	1.003
CGL51	sexratio1844	agecat					f_mljail	0.975	0.952	1.004
CGL52	sexratio1844		newincome		newemploy			0.976	0.938	0.988
CGL53	sexratio1844		newincome			homeless		0.976	0.943	1.002
CGL54	sexratio1844		newincome				f_mljail	0.975	0.937	0.998
CGL55	sexratio1844			newschool		homeless		0.977	0.945	1.004
CGL56	sexratio1844			newschool			f_mljail	0.977	0.940	1.001
CGL57	sexratio1844				newemploy		f_mljail	0.976	0.940	0.990
CGL58	sexratio1844	agecat						0.975	0.949	1.002
CGL59	sexratio1844		newincome					0.975	0.934	0.995
CGL60	sexratio1844			newschool				0.976	0.937	0.998
CGL61	sexratio1844				newemploy			0.975	0.938	0.988
CGL62	sexratio1844					homeless		0.975	0.945	1.006
CGL63	sexratio1844						f_mljail	0.974	0.938	1.001
CGL64	sexratio1844							0.973	0.930	1.004

Table 9. GENMOD Model Odds Ratios for Black Matched Sex Ratio, 0+

model #	exposure	model covariates						OR	95% CI, lower	95% CI, upper
DGE1	blassexratio0	agecat	newincome	newschool	newemploy	homeless	f_mljail	0.989	0.974	1.004
DGE2	blassexratio0	agecat	newincome	newschool	newemploy	homeless		0.988	0.970	1.005
DGE3	blassexratio0	agecat	newincome	newschool	newemploy		f_mljail	0.990	0.974	1.005
DGE4	blassexratio0	agecat	newincome	newschool		homeless	f_mljail	0.989	0.976	1.004
DGE5	blassexratio0	agecat	newincome		newemploy	homeless	f_mljail	0.988	0.973	1.003
DGE6	blassexratio0	agecat		newschool	newemploy	homeless	f_mljail	0.989	0.974	1.004
DGE7	blassexratio0		newincome	newschool	newemploy	homeless	f_mljail	0.991	0.976	1.006
DGE8	blassexratio0			newschool	newemploy	homeless	f_mljail	0.990	0.975	1.006
DGE9	blassexratio0	agecat			newemploy	homeless	f_mljail	0.988	0.971	1.005
DGE10	blassexratio0	agecat	newincome			homeless	f_mljail	0.988	0.974	1.002
DGE11	blassexratio0	agecat	newincome	newschool			f_mljail	0.990	0.975	1.005
DGE12	blassexratio0	agecat	newincome	newschool	newemploy			0.988	0.970	1.007
DGE13	blassexratio0		newincome		newemploy	homeless	f_mljail	0.990	0.975	1.005
DGE14	blassexratio0		newincome	newschool		homeless	f_mljail	0.991	0.976	1.006
DGE15	blassexratio0		newincome	newschool	newemploy		f_mljail	0.992	0.976	1.008
DGE16	blassexratio0		newincome	newschool	newemploy	homeless		0.989	0.972	1.007
DGE17	blassexratio0	agecat		newschool		homeless	f_mljail	0.990	0.976	1.003
DGE18	blassexratio0	agecat		newschool	newemploy		f_mljail	0.990	0.975	1.005
DGE19	blassexratio0	agecat		newschool	newemploy	homeless		0.988	0.971	1.005
DGE20	blassexratio0	agecat	newincome		newemploy		f_mljail	0.989	0.973	1.005
DGE21	blassexratio0	agecat	newincome		newemploy	homeless		0.987	0.969	1.004
DGE22	blassexratio0	agecat	newincome	newschool		homeless		0.988	0.972	1.004

DGE23	blassexratio0				newemploy	homeless	f_mljail	0.989	0.974	1.005
DGE24	blassexratio0	agecat				homeless	f_mljail	0.988	0.975	1.002
DGE25	blassexratio0	agecat	newincome				f_mljail	0.988	0.973	1.005
DGE26	blassexratio0	agecat	newincome	newschool				0.988	0.970	1.006
DGE27	blassexratio0			newschool		homeless	f_mljail	0.991	0.977	1.006
DGE28	blassexratio0			newschool	newemploy		f_mljail	0.992	0.976	1.008
DGE29	blassexratio0			newschool	newemploy	homeless		0.989	0.972	1.007
DGE30	blassexratio0		newincome			homeless	f_mljail	0.989	0.975	1.004
DGE31	blassexratio0		newincome		newemploy		f_mljail	0.991	0.975	1.007
DGE32	blassexratio0		newincome		newemploy	homeless		0.989	0.971	1.006
DGE33	blassexratio0		newincome	newschool			f_mljail	0.992	0.975	1.009
DGE34	blassexratio0		newincome	newschool		homeless		0.990	0.974	1.006
DGE35	blassexratio0		newincome	newschool	newemploy			0.990	0.972	1.009
DGE36	blassexratio0	agecat			newemploy		f_mljail	0.989	0.973	1.004
DGE37	blassexratio0	agecat			newemploy	homeless		0.987	0.970	1.004
DGE38	blassexratio0	agecat		newschool			f_mljail	0.991	0.977	1.005
DGE39	blassexratio0	agecat		newschool		homeless		0.988	0.973	1.004
DGE40	blassexratio0	agecat		newschool	newemploy			0.988	0.971	1.006
DGE41	blassexratio0	agecat	newincome			homeless		0.986	0.970	1.003
DGE42	blassexratio0	agecat	newincome		newemploy			0.987	0.969	1.006
DGE43	blassexratio0	agecat	newincome					0.987	0.968	1.006
DGE44	blassexratio0		newincome	newschool				0.990	0.969	1.013
DGE45	blassexratio0			newschool	newemploy			0.990	0.972	1.009
DGE46	blassexratio0				newemploy	homeless		0.988	0.971	1.006
DGE47	blassexratio0					homeless	f_mljail	0.989	0.975	1.004
DGE48	blassexratio0	agecat		newschool				0.989	0.972	1.006
DGE49	blassexratio0	agecat			newemploy			0.987	0.970	1.005

DGE50	blassexratio0	agecat				homeless		0.987	0.972	1.002
DGE51	blassexratio0	agecat					f_mljail	0.989	0.975	1.004
DGE52	blassexratio0		newincome		newemploy			0.989	0.971	1.008
DGE53	blassexratio0		newincome			homeless		0.989	0.973	1.005
DGE54	blassexratio0		newincome				f_mljail	0.990	0.972	1.008
DGE55	blassexratio0			newschool		homeless		0.990	0.975	1.006
DGE56	blassexratio0			newschool			f_mljail	0.992	0.976	1.009
DGE57	blassexratio0				newemploy		f_mljail	0.991	0.975	1.007
DGE58	blassexratio0	agecat						0.987	0.970	1.005
DGE59	blassexratio0		newincome					0.988	0.968	1.009
DGE60	blassexratio0			newschool				0.991	0.972	1.010
DGE61	blassexratio0				newemploy			0.989	0.971	1.008
DGE62	blassexratio0					homeless		0.989	0.974	1.004
DGE63	blassexratio0						f_mljail	0.990	0.972	1.008
DGE64	blassexratio0							0.988	0.969	1.008

Table 10. GLIMMIX Model Odds Ratios for Black Matched Sex Ratio, 0+

model #	exposure	model covariates						OR	95% CI, lower	95% CI, upper
DGL1	blassexratio0	agecat	newincome	newschool	newemploy	homeless	f_mljail	0.990	0.978	1.003
DGL2	blassexratio0	agecat	newincome	newschool	newemploy	homeless		0.990	0.978	1.003
DGL3	blassexratio0	agecat	newincome	newschool	newemploy		f_mljail	0.991	0.979	1.003
DGL4	blassexratio0	agecat	newincome	newschool		homeless	f_mljail	0.991	0.979	1.004
DGL5	blassexratio0	agecat	newincome		newemploy	homeless	f_mljail	0.990	0.978	1.002
DGL6	blassexratio0	agecat		newschool	newemploy	homeless	f_mljail	0.990	0.978	1.003
DGL7	blassexratio0		newincome	newschool	newemploy	homeless	f_mljail	0.991	0.979	1.004
DGL8	blassexratio0			newschool	newemploy	homeless	f_mljail	0.991	0.979	1.004
DGL9	blassexratio0	agecat			newemploy	homeless	f_mljail	0.990	0.978	1.002
DGL10	blassexratio0	agecat	newincome			homeless	f_mljail	0.991	0.978	1.003
DGL11	blassexratio0	agecat	newincome	newschool			f_mljail	0.992	0.980	1.005
DGL12	blassexratio0	agecat	newincome	newschool	newemploy			0.991	0.978	1.004
DGL13	blassexratio0		newincome		newemploy	homeless	f_mljail	0.991	0.979	1.003
DGL14	blassexratio0		newincome	newschool		homeless	f_mljail	0.992	0.980	1.005
DGL15	blassexratio0		newincome	newschool	newemploy		f_mljail	0.992	0.980	1.005
DGL16	blassexratio0		newincome	newschool	newemploy	homeless		0.991	0.978	1.004
DGL17	blassexratio0	agecat		newschool		homeless	f_mljail	0.991	0.979	1.003
DGL18	blassexratio0	agecat		newschool	newemploy		f_mljail	0.991	0.979	1.003
DGL19	blassexratio0	agecat		newschool	newemploy	homeless		0.990	0.978	1.003
DGL20	blassexratio0	agecat	newincome		newemploy		f_mljail	0.990	0.978	1.003
DGL21	blassexratio0	agecat	newincome		newemploy	homeless		0.990	0.977	1.003
DGL22	blassexratio0	agecat	newincome	newschool		homeless		0.991	0.979	1.004

DGL23	blassexratio0				newemploy	homeless	f_mljail	0.991	0.979	1.003
DGL24	blassexratio0	agecat				homeless	f_mljail	0.990	0.978	1.002
DGL25	blassexratio0	agecat	newincome				f_mljail	0.991	0.979	1.004
DGL26	blassexratio0	agecat	newincome	newschool				0.992	0.979	1.005
DGL27	blassexratio0			newschool		homeless	f_mljail	0.992	0.980	1.005
DGL28	blassexratio0			newschool	newemploy		f_mljail	0.992	0.980	1.005
DGL29	blassexratio0			newschool	newemploy	homeless		0.991	0.978	1.004
DGL30	blassexratio0		newincome			homeless	f_mljail	0.992	0.979	1.005
DGL31	blassexratio0		newincome		newemploy		f_mljail	0.992	0.980	1.004
DGL32	blassexratio0		newincome		newemploy	homeless		0.991	0.978	1.004
DGL33	blassexratio0		newincome	newschool			f_mljail	0.994	0.981	1.007
DGL34	blassexratio0		newincome	newschool		homeless		0.992	0.979	1.006
DGL35	blassexratio0		newincome	newschool	newemploy			0.992	0.979	1.005
DGL36	blassexratio0	agecat			newemploy		f_mljail	0.990	0.978	1.003
DGL37	blassexratio0	agecat			newemploy	homeless		0.990	0.977	1.002
DGL38	blassexratio0	agecat		newschool			f_mljail	0.992	0.980	1.004
DGL39	blassexratio0	agecat		newschool		homeless		0.991	0.978	1.004
DGL40	blassexratio0	agecat		newschool	newemploy			0.991	0.978	1.004
DGL41	blassexratio0	agecat	newincome			homeless		0.990	0.978	1.003
DGL42	blassexratio0	agecat	newincome		newemploy			0.990	0.978	1.003
DGL43	blassexratio0	agecat	newincome					0.991	0.978	1.004
DGL44	blassexratio0		newincome	newschool				0.994	0.980	1.007
DGL45	blassexratio0			newschool	newemploy			0.992	0.979	1.005
DGL46	blassexratio0				newemploy	homeless		0.990	0.978	1.003
DGL47	blassexratio0					homeless	f_mljail	0.991	0.979	1.004
DGL48	blassexratio0	agecat		newschool				0.992	0.979	1.005
DGL49	blassexratio0	agecat			newemploy			0.990	0.978	1.003

DGL50	blassexratio0	agecat				homeless		0.990	0.977	1.003
DGL51	blassexratio0	agecat					f_mljail	0.991	0.979	1.004
DGL52	blassexratio0		newincome		newemploy			0.992	0.979	1.005
DGL53	blassexratio0		newincome			homeless		0.992	0.978	1.005
DGL54	blassexratio0		newincome				f_mljail	0.993	0.980	1.006
DGL55	blassexratio0			newschool		homeless		0.992	0.979	1.005
DGL56	blassexratio0			newschool			f_mljail	0.994	0.981	1.007
DGL57	blassexratio0				newemploy		f_mljail	0.992	0.980	1.004
DGL58	blassexratio0	agecat						0.991	0.978	1.004
DGL59	blassexratio0		newincome					0.993	0.980	1.007
DGL60	blassexratio0			newschool				0.993	0.980	1.007
DGL61	blassexratio0				newemploy			0.991	0.979	1.004
DGL62	blassexratio0					homeless		0.991	0.978	1.005
DGL63	blassexratio0						f_mljail	0.993	0.980	1.006
DGL64	blassexratio0							0.993	0.979	1.006

Table 11. GENMOD Model Odds Ratios Black Matched Sex Ratio, 18+

model #	exposure	model covariates						OR	95% CI, lower	95% CI, upper
EGE1	blassexratio18	agecat	newincome	newschool	newemploy	homeless	f_mljail	0.969	0.969	1.005
EGE2	blassexratio18	agecat	newincome	newschool	newemploy	homeless		0.985	0.964	1.006
EGE3	blassexratio18	agecat	newincome	newschool	newemploy		f_mljail	0.987	0.969	1.006
EGE4	blassexratio18	agecat	newincome	newschool		homeless	f_mljail	0.988	0.972	1.004
EGE5	blassexratio18	agecat	newincome		newemploy	homeless	f_mljail	0.986	0.968	1.004
EGE6	blassexratio18	agecat		newschool	newemploy	homeless	f_mljail	0.986	0.969	1.005
EGE7	blassexratio18		newincome	newschool	newemploy	homeless	f_mljail	0.988	0.970	1.007
EGE8	blassexratio18			newschool	newemploy	homeless	f_mljail	0.988	0.970	1.007
EGE9	blassexratio18	agecat			newemploy	homeless	f_mljail	0.985	0.968	1.004
EGE10	blassexratio18	agecat	newincome			homeless	f_mljail	0.986	0.970	1.003
EGE11	blassexratio18	agecat	newincome	newschool			f_mljail	0.988	0.972	1.005
EGE12	blassexratio18	agecat	newincome	newschool	newemploy			0.985	0.964	1.007
EGE13	blassexratio18		newincome		newemploy	homeless	f_mljail	0.987	0.969	1.006
EGE14	blassexratio18		newincome	newschool		homeless	f_mljail	0.990	0.973	1.002
EGE15	blassexratio18		newincome	newschool	newemploy		f_mljail	0.989	0.970	1.008
EGE16	blassexratio18		newincome	newschool	newemploy	homeless		0.986	0.965	1.008
EGE17	blassexratio18	agecat		newschool		homeless	f_mljail	0.988	0.973	1.004
EGE18	blassexratio18	agecat		newschool	newemploy		f_mljail	0.987	0.969	1.006
EGE19	blassexratio18	agecat		newschool	newemploy	homeless		0.985	0.964	1.006
EGE20	blassexratio18	agecat	newincome		newemploy		f_mljail	0.986	0.967	1.005
EGE21	blassexratio18	agecat	newincome		newemploy	homeless		0.984	0.963	1.005
EGE22	blassexratio18	agecat	newincome	newschool		homeless		0.986	0.968	1.005

EGE23	blassexratio18				newemploy	homeless	f_mljail	0.987	0.969	1.006
EGE24	blassexratio18	agecat				homeless	f_mljail	0.987	0.972	1.002
EGE25	blassexratio18	agecat	newincome				f_mljail	0.987	0.969	1.005
EGE26	blassexratio18	agecat	newincome	newschool				0.986	0.967	1.007
EGE27	blassexratio18			newschool		homeless	f_mljail	0.990	0.974	1.006
EGE28	blassexratio18			newschool	newemploy		f_mljail	0.989	0.970	1.008
EGE29	blassexratio18			newschool	newemploy	homeless		0.986	0.965	1.009
EGE30	blassexratio18		newincome			homeless	f_mljail	0.988	0.972	1.005
EGE31	blassexratio18		newincome		newemploy		f_mljail	0.988	0.969	1.008
EGE32	blassexratio18		newincome		newemploy	homeless		0.986	0.964	1.008
EGE33	blassexratio18		newincome	newschool			f_mljail	0.990	0.972	1.009
EGE34	blassexratio18		newincome	newschool		homeless		0.988	0.970	1.007
EGE35	blassexratio18		newincome	newschool	newemploy			0.987	0.965	1.010
EGE36	blassexratio18	agecat			newemploy		f_mljail	0.986	0.968	1.005
EGE37	blassexratio18	agecat			newemploy	homeless		0.984	0.963	1.005
EGE38	blassexratio18	agecat		newschool			f_mljail	0.989	0.973	1.005
EGE39	blassexratio18	agecat		newschool		homeless		0.986	0.969	1.004
EGE40	blassexratio18	agecat		newschool	newemploy			0.985	0.964	1.007
EGE41	blassexratio18	agecat	newincome			homeless		0.985	0.966	1.003
EGE42	blassexratio18	agecat	newincome		newemploy			0.984	0.963	1.006
EGE43	blassexratio18	agecat	newincome					0.985	0.965	1.006
EGE44	blassexratio18		newincome	newschool				0.989	0.968	1.010
EGE45	blassexratio18			newschool	newemploy			0.987	0.965	1.010
EGE46	blassexratio18				newemploy	homeless		1.015	0.964	1.008
EGE47	blassexratio18					homeless	f_mljail	0.988	0.972	1.004
EGE48	blassexratio18	agecat		newschool				0.987	0.969	1.006
EGE49	blassexratio18	agecat			newemploy			0.984	0.963	1.006

EGE50	blassexratio18	agecat				homeless		0.985	0.968	1.002
EGE51	blassexratio18	agecat					f_mljail	0.988	0.971	1.004
EGE52	blassexratio18		newincome		newemploy			0.986	0.963	1.010
EGE53	blassexratio18		newincome			homeless		0.987	0.969	1.006
EGE54	blassexratio18		newincome				f_mljail	0.989	0.969	1.008
EGE55	blassexratio18			newschool		homeless		0.989	0.971	1.007
EGE56	blassexratio18			newschool			f_mljail	0.991	0.973	1.009
EGE57	blassexratio18				newemploy		f_mljail	0.988	0.969	1.008
EGE58	blassexratio18	agecat						0.986	0.967	1.005
EGE59	blassexratio18		newincome					0.987	0.965	1.009
EGE60	blassexratio18			newschool				0.990	0.970	1.010
EGE61	blassexratio18				newemploy			0.986	0.964	1.009
EGE62	blassexratio18					homeless		0.987	0.970	1.005
EGE63	blassexratio18						f_mljail	0.989	0.970	1.008
EGE64	blassexratio18							0.987	0.967	1.008

Table 12. GLIMMIX Model Odds Ratios Black Matched Sex Ratio, 18+

model #	exposure	model covariates						OR	95% CI, lower	95% CI, upper
EGL1	blassexratio18	agecat	newincome	newschool	newemploy	homeless	f_mljail	0.990	0.977	1.003
EGL2	blassexratio18	agecat	newincome	newschool	newemploy	homeless		0.990	0.976	1.003
EGL3	blassexratio18	agecat	newincome	newschool	newemploy		f_mljail	0.990	0.977	1.003
EGL4	blassexratio18	agecat	newincome	newschool		homeless	f_mljail	0.991	0.978	1.004
EGL5	blassexratio18	agecat	newincome		newemploy	homeless	f_mljail	0.989	0.976	1.002
EGL6	blassexratio18	agecat		newschool	newemploy	homeless	f_mljail	0.990	0.977	1.003
EGL7	blassexratio18		newincome	newschool	newemploy	homeless	f_mljail	0.990	0.977	1.004
EGL8	blassexratio18			newschool	newemploy	homeless	f_mljail	0.990	0.977	1.004
EGL9	blassexratio18	agecat			newemploy	homeless	f_mljail	0.989	0.976	1.002
EGL10	blassexratio18	agecat	newincome			homeless	f_mljail	0.990	0.977	1.003
EGL11	blassexratio18	agecat	newincome	newschool			f_mljail	0.991	0.978	1.004
EGL12	blassexratio18	agecat	newincome	newschool	newemploy			0.990	0.977	1.004
EGL13	blassexratio18		newincome		newemploy	homeless	f_mljail	0.990	0.977	1.003
EGL14	blassexratio18		newincome	newschool		homeless	f_mljail	0.992	0.978	1.005
EGL15	blassexratio18		newincome	newschool	newemploy		f_mljail	0.991	0.978	1.005
EGL16	blassexratio18		newincome	newschool	newemploy	homeless		0.990	0.976	1.004
EGL17	blassexratio18	agecat		newschool		homeless	f_mljail	0.990	0.977	1.003
EGL18	blassexratio18	agecat		newschool	newemploy		f_mljail	0.990	0.977	1.003
EGL19	blassexratio18	agecat		newschool	newemploy	homeless		0.989	0.976	1.003
EGL20	blassexratio18	agecat	newincome		newemploy		f_mljail	0.990	0.977	1.003
EGL21	blassexratio18	agecat	newincome		newemploy	homeless		0.989	0.976	1.003
EGL22	blassexratio18	agecat	newincome	newschool		homeless		0.990	0.977	1.004

EGL23	blassexratio18				newemploy	homeless	f_mljail	0.990	0.977	1.003
EGL24	blassexratio18	agecat				homeless	f_mljail	0.989	0.976	1.002
EGL25	blassexratio18	agecat	newincome				f_mljail	0.991	0.978	1.004
EGL26	blassexratio18	agecat	newincome	newschool				0.991	0.978	1.005
EGL27	blassexratio18			newschool		homeless	f_mljail	0.991	0.978	1.005
EGL28	blassexratio18			newschool	newemploy		f_mljail	0.991	0.978	1.005
EGL29	blassexratio18			newschool	newemploy	homeless		0.990	0.976	1.004
EGL30	blassexratio18		newincome			homeless	f_mljail	0.991	0.977	1.005
EGL31	blassexratio18		newincome		newemploy		f_mljail	0.991	0.978	1.004
EGL32	blassexratio18		newincome		newemploy	homeless		0.990	0.976	1.004
EGL33	blassexratio18		newincome	newschool			f_mljail	0.993	0.979	1.007
EGL34	blassexratio18		newincome	newschool		homeless		0.991	0.977	1.006
EGL35	blassexratio18		newincome	newschool	newemploy			0.991	0.977	1.005
EGL36	blassexratio18	agecat			newemploy		f_mljail	0.989	0.977	1.003
EGL37	blassexratio18	agecat			newemploy	homeless		0.989	0.975	1.002
EGL38	blassexratio18	agecat		newschool			f_mljail	0.991	0.978	1.004
EGL39	blassexratio18	agecat		newschool		homeless		0.990	0.977	1.004
EGL40	blassexratio18	agecat		newschool	newemploy			0.990	0.977	1.004
EGL41	blassexratio18	agecat	newincome			homeless		0.990	0.976	1.003
EGL42	blassexratio18	agecat	newincome		newemploy			0.990	0.976	1.003
EGL43	blassexratio18	agecat	newincome					0.990	0.977	1.004
EGL44	blassexratio18		newincome	newschool				0.992	0.978	1.007
EGL45	blassexratio18			newschool	newemploy			0.991	0.977	1.005
EGL46	blassexratio18				newemploy	homeless		0.990	0.976	1.004
EGL47	blassexratio18					homeless	f_mljail	0.990	0.977	1.004
EGL48	blassexratio18	agecat		newschool				0.991	0.978	1.004
EGL49	blassexratio18	agecat			newemploy			0.989	0.976	1.003

EGL50	blassexratio18	agecat				homeless		0.989	0.976	1.003
EGL51	blassexratio18	agecat					f_mljail	0.990	0.977	1.003
EGL52	blassexratio18		newincome		newemploy			0.991	0.977	1.005
EGL53	blassexratio18		newincome			homeless		0.991	0.977	1.005
EGL54	blassexratio18		newincome				f_mljail	0.992	0.978	1.006
EGL55	blassexratio18			newschool		homeless		0.991	0.977	1.005
EGL56	blassexratio18			newschool			f_mljail	0.993	0.979	1.007
EGL57	blassexratio18				newemploy		f_mljail	0.991	0.978	1.004
EGL58	blassexratio18	agecat						0.990	0.977	1.004
EGL59	blassexratio18		newincome					0.992	0.978	1.007
EGL60	blassexratio18			newschool				0.992	0.978	1.007
EGL61	blassexratio18				newemploy			0.990	0.977	1.004
EGL62	blassexratio18					homeless		0.990	0.976	1.004
EGL63	blassexratio18						f_mljail	0.992	0.978	1.006
EGL64	blassexratio18							0.992	0.977	1.006

Table 13. GENMOD Model Odds Ratios for Black Matched Sex Ratio, 18-44

model #	exposure	model covariates						OR	95% CI, lower	95% CI, upper
FGE1	blassexratio1844	agecat	newincome	newschool	newemploy	homeless	f_mljail	0.983	0.957	1.010
FGE2	blassexratio1844	agecat	newincome	newschool	newemploy	homeless		0.982	0.954	1.010
FGE3	blassexratio1844	agecat	newincome	newschool	newemploy		f_mljail	0.984	0.957	1.011
FGE4	blassexratio1844	agecat	newincome	newschool		homeless	f_mljail	0.984	0.959	1.009
FGE5	blassexratio1844	agecat	newincome		newemploy	homeless	f_mljail	0.982	0.955	1.009
FGE6	blassexratio1844	agecat		newschool	newemploy	homeless	f_mljail	0.983	0.957	1.010
FGE7	blassexratio1844		newincome	newschool	newemploy	homeless	f_mljail	0.985	0.958	1.012
FGE8	blassexratio1844			newschool	newemploy	homeless	f_mljail	0.985	0.958	1.013
FGE9	blassexratio1844	agecat			newemploy	homeless	f_mljail	0.981	0.955	1.009
FGE10	blassexratio1844	agecat	newincome			homeless	f_mljail	0.982	0.956	1.008
FGE11	blassexratio1844	agecat	newincome	newschool			f_mljail	0.984	0.958	1.011
FGE12	blassexratio1844	agecat	newincome	newschool	newemploy			0.982	0.954	1.011
FGE13	blassexratio1844		newincome		newemploy	homeless	f_mljail	0.984	0.957	1.012
FGE14	blassexratio1844		newincome	newschool		homeless	f_mljail	0.986	0.959	1.013
FGE15	blassexratio1844		newincome	newschool	newemploy		f_mljail	0.986	0.959	1.014
FGE16	blassexratio1844		newincome	newschool	newemploy	homeless		0.984	0.955	1.013
FGE17	blassexratio1844	agecat		newschool		homeless	f_mljail	0.984	0.961	1.009
FGE18	blassexratio1844	agecat		newschool	newemploy		f_mljail	0.984	0.958	1.011
FGE19	blassexratio1844	agecat		newschool	newemploy	homeless		0.982	0.955	1.010
FGE20	blassexratio1844	agecat	newincome		newemploy		f_mljail	0.982	0.955	1.010
FGE21	blassexratio1844	agecat	newincome		newemploy	homeless		0.981	0.953	1.009
FGE22	blassexratio1844	agecat	newincome	newschool		homeless		0.982	0.957	1.009

FGE23	blassexratio1844				newemploy	homeless	f_mljail	0.984	0.956	1.012
FGE24	blassexratio1844	agecat				homeless	f_mljail	0.982	0.958	1.007
FGE25	blassexratio1844	agecat	newincome				f_mljail	0.982	0.955	1.011
FGE26	blassexratio1844	agecat	newincome	newschool				0.983	0.955	1.011
FGE27	blassexratio1844			newschool		homeless	f_mljail	0.986	0.960	1.013
FGE28	blassexratio1844			newschool	newemploy		f_mljail	0.986	0.959	1.014
FGE29	blassexratio1844			newschool	newemploy	homeless		0.983	0.954	1.013
FGE30	blassexratio1844		newincome			homeless	f_mljail	0.984	0.955	1.013
FGE31	blassexratio1844		newincome		newemploy		f_mljail	0.990	0.957	1.014
FGE32	blassexratio1844		newincome		newemploy	homeless		0.983	0.954	1.012
FGE33	blassexratio1844		newincome	newschool			f_mljail	0.986	0.955	1.018
FGE34	blassexratio1844		newincome	newschool		homeless		0.985	0.958	1.013
FGE35	blassexratio1844		newincome	newschool	newemploy			0.985	0.955	1.015
FGE36	blassexratio1844	agecat			newemploy		f_mljail	0.982	0.955	1.010
FGE37	blassexratio1844	agecat			newemploy	homeless		0.980	0.952	1.009
FGE38	blassexratio1844	agecat		newschool			f_mljail	0.985	0.961	1.010
FGE39	blassexratio1844	agecat		newschool		homeless		0.983	0.958	1.009
FGE40	blassexratio1844	agecat		newschool	newemploy			0.982	0.955	1.011
FGE41	blassexratio1844	agecat	newincome			homeless		0.981	0.955	1.008
FGE42	blassexratio1844	agecat	newincome		newemploy			0.981	0.953	1.010
FGE43	blassexratio1844	agecat	newincome					0.981	0.953	1.009
FGE44	blassexratio1844		newincome	newschool				0.985	0.954	1.017
FGE45	blassexratio1844			newschool	newemploy			0.985	0.955	1.015
FGE46	blassexratio1844				newemploy	homeless		0.982	0.953	1.012
FGE47	blassexratio1844					homeless	f_mljail	0.984	0.956	1.012
FGE48	blassexratio1844	agecat		newschool				0.984	0.958	1.010
FGE49	blassexratio1844	agecat			newemploy			0.981	0.953	1.010

FGE50	blassexratio1844	agecat				homeless		0.981	0.957	1.007
FGE51	blassexratio1844	agecat					f_mljail	0.983	0.957	1.010
FGE52	blassexratio1844		newincome		newemploy			0.983	0.954	1.014
FGE53	blassexratio1844		newincome			homeless		0.983	0.956	1.011
FGE54	blassexratio1844		newincome				f_mljail	0.983	0.949	1.018
FGE55	blassexratio1844			newschool		homeless		0.986	0.960	1.012
FGE56	blassexratio1844			newschool			f_mljail	0.987	0.957	1.017
FGE57	blassexratio1844				newemploy		f_mljail	0.985	0.956	1.014
FGE58	blassexratio1844	agecat						0.982	0.956	1.009
FGE59	blassexratio1844		newincome					0.982	0.951	1.015
FGE60	blassexratio1844			newschool				0.986	0.956	1.016
FGE61	blassexratio1844				newemploy			0.983	0.953	1.014
FGE62	blassexratio1844					homeless		0.984	0.958	1.010
FGE63	blassexratio1844						f_mljail	0.983	0.950	1.017
FGE64	blassexratio1844							0.983	0.952	1.015

Table 14. GLIMMIX Model Odds Ratios for Black Matched Sex Ratio, 18-44

model #	exposure	model covariates						OR	95% CI, lower	95% CI, upper
FGL1	blassexratio1844	agecat	newincome	newschool	newemploy	homeless	f_mljail	0.989	0.974	1.004
FGL2	blassexratio1844	agecat	newincome	newschool	newemploy	homeless		0.989	0.975	1.004
FGL3	blassexratio1844	agecat	newincome	newschool	newemploy		f_mljail	0.989	0.974	1.004
FGL4	blassexratio1844	agecat	newincome	newschool		homeless	f_mljail	0.989	0.974	1.005
FGL5	blassexratio1844	agecat	newincome		newemploy	homeless	f_mljail	0.988	0.973	1.004
FGL6	blassexratio1844	agecat		newschool	newemploy	homeless	f_mljail	0.989	0.974	1.004
FGL7	blassexratio1844		newincome	newschool	newemploy	homeless	f_mljail	0.989	0.974	1.005
FGL8	blassexratio1844			newschool	newemploy	homeless	f_mljail	0.989	0.973	1.005
FGL9	blassexratio1844	agecat			newemploy	homeless	f_mljail	0.988	0.972	1.003
FGL10	blassexratio1844	agecat	newincome			homeless	f_mljail	0.988	0.973	1.004
FGL11	blassexratio1844	agecat	newincome	newschool			f_mljail	0.990	0.975	1.006
FGL12	blassexratio1844	agecat	newincome	newschool	newemploy			0.990	0.975	1.004
FGL13	blassexratio1844		newincome		newemploy	homeless	f_mljail	0.989	0.973	1.005
FGL14	blassexratio1844		newincome	newschool		homeless	f_mljail	0.990	0.973	1.007
FGL15	blassexratio1844		newincome	newschool	newemploy		f_mljail	0.990	0.975	1.006
FGL16	blassexratio1844		newincome	newschool	newemploy	homeless		0.990	0.974	1.005
FGL17	blassexratio1844	agecat		newschool		homeless	f_mljail	0.989	0.974	1.005
FGL18	blassexratio1844	agecat		newschool	newemploy		f_mljail	0.989	0.974	1.004
FGL19	blassexratio1844	agecat		newschool	newemploy	homeless		0.989	0.975	1.004
FGL20	blassexratio1844	agecat	newincome		newemploy		f_mljail	0.989	0.973	1.004
FGL21	blassexratio1844	agecat	newincome		newemploy	homeless		0.989	0.974	1.003
FGL22	blassexratio1844	agecat	newincome	newschool		homeless		0.990	0.975	1.005

FGL23	blassexratio1844				newemploy	homeless	f_mljail	0.989	0.973	1.005
FGL24	blassexratio1844	agecat				homeless	f_mljail	0.988	0.972	1.004
FGL25	blassexratio1844	agecat	newincome				f_mljail	0.989	0.973	1.005
FGL26	blassexratio1844	agecat	newincome	newschool				0.990	0.976	1.005
FGL27	blassexratio1844			newschool		homeless	f_mljail	0.990	0.973	1.007
FGL28	blassexratio1844			newschool	newemploy		f_mljail	0.990	0.975	1.006
FGL29	blassexratio1844			newschool	newemploy	homeless		0.989	0.974	1.005
FGL30	blassexratio1844		newincome			homeless	f_mljail	0.989	0.972	1.007
FGL31	blassexratio1844		newincome		newemploy		f_mljail	0.990	0.974	1.005
FGL32	blassexratio1844		newincome		newemploy	homeless		0.989	0.974	1.005
FGL33	blassexratio1844		newincome	newschool			f_mljail	0.991	0.974	1.008
FGL34	blassexratio1844		newincome	newschool		homeless		0.990	0.974	1.007
FGL35	blassexratio1844		newincome	newschool	newemploy			0.990	0.975	1.006
FGL36	blassexratio1844	agecat			newemploy		f_mljail	0.988	0.973	1.004
FGL37	blassexratio1844	agecat			newemploy	homeless		0.988	0.974	1.003
FGL38	blassexratio1844	agecat		newschool			f_mljail	0.990	0.975	1.005
FGL39	blassexratio1844	agecat		newschool		homeless		0.989	0.975	1.004
FGL40	blassexratio1844	agecat		newschool	newemploy			0.990	0.975	1.004
FGL41	blassexratio1844	agecat	newincome			homeless		0.989	0.974	1.004
FGL42	blassexratio1844	agecat	newincome		newemploy			0.989	0.975	1.004
FGL43	blassexratio1844	agecat	newincome					0.990	0.975	1.005
FGL44	blassexratio1844		newincome	newschool				0.991	0.975	1.008
FGL45	blassexratio1844			newschool	newemploy			0.990	0.975	1.006
FGL46	blassexratio1844				newemploy	homeless		0.989	0.973	1.004
FGL47	blassexratio1844					homeless	f_mljail	0.989	0.971	1.006
FGL48	blassexratio1844	agecat		newschool				0.990	0.976	1.005
FGL49	blassexratio1844	agecat			newemploy			0.989	0.974	1.003

FGL50	blassexratio1844	agecat				homeless		0.988	0.973	1.004
FGL51	blassexratio1844	agecat					f_mljail	0.989	0.973	1.005
FGL52	blassexratio1844		newincome		newemploy			0.990	0.975	1.005
FGL53	blassexratio1844		newincome			homeless		0.990	0.973	1.006
FGL54	blassexratio1844		newincome				f_mljail	0.990	0.973	1.008
FGL55	blassexratio1844			newschool		homeless		0.990	0.973	1.007
FGL56	blassexratio1844			newschool			f_mljail	0.991	0.974	1.008
FGL57	blassexratio1844				newemploy		f_mljail	0.989	0.974	1.005
FGL58	blassexratio1844	agecat						0.989	0.974	1.004
FGL59	blassexratio1844		newincome					0.991	0.974	1.007
FGL60	blassexratio1844			newschool				0.991	0.975	1.008
FGL61	blassexratio1844				newemploy			0.990	0.975	1.005
FGL62	blassexratio1844					homeless		0.989	0.972	1.006
FGL63	blassexratio1844						f_mljail	0.990	0.972	1.008
FGL64	blassexratio1844							0.990	0.973	1.007

Further Consideration of Certain Models

The algorithm converged for all GENMOD models. For all GLIMMIX models, the convergence criterion was satisfied. The ORs were fairly similar between the GENMOD and GLIMMIX models across combinations of variables for each distinct sex ratio. For instance, the OR for the overall sex ratio accounting for all men women of all races/ethnicities ages 18 years and older that was based on the model including agecat, newincome, newschool, newemploy, f_mljail in addition to the exposure (sexratio18) was 0.972 (95% CI: 0.946-0.994) for the GENMOD model and 0.978 (95% CI: 0.950-1.007) for the GLIMMIX model. As expected, precision tended to increase as the number of variables included in a particular model decreased.

The sex ratio ORs for all GENMOD and GLIMMIX models, including ORs for the "reduced" model, were within 10% of the relevant "full" ORs. Therefore, it would be valid, based on the predetermined approach, to drop all covariates from all variables at this point. However, based on proximity to the "full" OR, precision as determined by CI width, parsimony (i.e., number of variables in model), and relation between the constitution of the relevant GENMOD and GLIMMIX models, certain models were given further consideration. The models considered further for each sex ratio of interest are presented in Table 15.

Table 15. GENMOD and GLIMMIX Models given Further Consideration for Each Sex Ratio of Interest

GENMOD #	GLIMMIX #	exposure	model covariates					
AGE1	**AGL1**	sexratio0	agecat	newincome	newschool	newemploy	homeless	f_mljail
AGE30	**AGL30**	sexratio0		newincome			homeless	f_mljail
AGE43	**AGL43**	sexratio0	agecat	newincome				
AGE64	**AGL64**	sexratio0						
BGE1	**BGL1**	sexratio18	agecat	newincome	newschool	newemploy	homeless	f_mljail
BGE18	**BGL18**	sexratio18	agecat		newschool	newemploy		f_mljail
BGE53	**BGL53**	sexratio18		newincome			homeless	
BGE64	**BGL64**	sexratio18						
CGE1	**CGL1**	sexratio1844	agecat	newincome	newschool	newemploy	homeless	f_mljail
CGE43	**CGL43**	sexratio1844	agecat	newincome				
CGE53	**CGL53**	sexratio1844		newincome			homeless	
CGE64	**CGL64**	sexratio1844						
DGE1	**DGL1**	blassexratio0	agecat	newincome	newschool	newemploy	homeless	f_mljail
DGE47	**DGL47**	blassexratio0					homeless	f_mljail
DGE62	**DGL62**	blassexratio0					homeless	
DGE64	**DGL64**	blassexratio0						

EGE1	**EGL1**	blassexratio18	agecat	newincome	newschool	newemploy	homeless	f_mljail
EGE42	**EGL42**	blassexratio18	agecat	newincome		newemploy		
EGE46	**EGL46**	blassexratio18				newemploy	homeless	
EGE64	**EGL64**	blassexratio18						
FGE1	**FGL1**	blassexratio1844	agecat	newincome	newschool	newemploy	homeless	f_mljail
FGE51	**FGL51**	blassexratio1844	agecat					f_mljail
FGE61	**FGL61**	blassexratio1844				newemploy		
FGE64	**FGL64**	blassexratio1844						

The first step in further considering certain models was to look at certain "estimate" statements for the GENMOD models and "at" suboptions for the GLIMMIX models. "Estimate" statements were used instead of "contrast" statements because the sex ratios are continuous. The "estimate" statement specifies coefficients of a linear combination of model parameters defining a difference between two groups. For each GENMOD model, the following comparisons were run:

- Median vs. 25^{th} percentile.
- Median vs. 75^{th} percentile.
- Mean vs. lowest value.
- Mean vs. highest value.

Similar comparisons were made for the GLIMMIX models using the "at" suboption of the "oddsratio" option. The mean, median, lowest, highest, 25^{th}, and 75^{th} percentile values used in calculating the "estimate" statements and "at" suboptions are presented in Table 16.

Table 16. Values Used in Calculating "Estimate" Statements and "At" Suboptions

exposure	mean	median	low	high	25th percentile	75th percentile
sexratio0	92.51	90.28	82.19	123.89	86.37	98.59
sexratio18	87.36	87.11	74.65	120.75	79.99	92.90
sexratio1844	96.75	96.46	78.24	118.10	90.19	102.84
blassexratio0	90.36	88.38	74.74	198.41	84.36	90.32
blassexratio18	83.06	80.26	68.42	199.25	74.95	85.48
blassexratio1844	91.08	88.72	47.53	213.53	84.98	93.58

The ORs associated with the four comparisons listed above are presented in Table 17. As evidenced in Table 17, when comparisons more extreme than a one-unit change in the relevant sex ratio are explored, greater differences between the GENMOD and GLIMMIX ORs are seen.

Table 17. Odds Ratios Associated with Changes in Value of Sex Ratio of Interest, GENMOD and GLIMMIX Models

		median vs. 25th percentile	median vs. 75th percentile	mean vs. lowest value	mean vs. highest value
model #	**exposure**	**OR**	**OR**	**OR**	**OR**
AGE1	sexratio0	0.472	0.441	0.427	0.289
AGL1	sexratio0	0.912	0.822	0.784	0.478
AGE30	sexratio0	0.473	0.443	0.429	0.295
AGL30	sexratio0	0.911	0.819	0.781	0.471
AGE43	sexratio0	0.472	0.440	0.426	0.288
AGL43	sexratio0	0.914	0.826	0.789	0.486
AGE64	sexratio0	0.468	0.433	0.417	0.266
AGL64	sexratio0	0.907	0.812	0.773	0.456
BGE1	sexratio18	0.452	0.461	0.414	0.287
BGL1	sexratio18	0.854	0.880	0.754	0.478
BGE18	sexratio18	0.450	0.460	0.412	0.282
BGL18	sexratio18	0.855	0.880	0.755	0.479
BGE53	sexratio18	0.450	0.459	0.411	0.280
BGL53	sexratio18	0.849	0.875	0.746	0.464
BGE64	sexratio18	0.446	0.456	0.403	0.264
BGL64	sexratio18	0.845	0.872	0.739	0.454
CGE1	sexratio1844	0.456	0.455	0.372	0.354
CGL1	sexratio1844	0.869	0.864	0.660	0.620
CGE43	sexratio1844	0.456	0.456	0.373	0.355
CGL43	sexratio1844	0.862	0.860	0.644	0.603
CGE53	sexratio1844	0.455	0.455	0.371	0.352
CGL53	sexratio1844	0.857	0.855	0.634	0.591

CGE64	sexratio1844	0.446	0.445	0.346	0.324
CGL64	sexratio1844	0.844	0.841	0.605	0.561
DGE1	blassexratio0	0.489	0.495	0.457	0.232
DGL1	blassexratio0	0.962	0.982	0.861	0.356
DGE47	blassexratio0	0.489	0.495	0.458	0.238
DGL47	blassexratio0	0.966	0.983	0.872	0.390
DGE62	blassexratio0	0.489	0.495	0.456	0.229
DGL62	blassexratio0	0.965	0.983	0.869	0.379
DGE64	blassexratio0	0.488	0.494	0.455	0.223
DGL64	blassexratio0	0.970	0.986	0.890	0.446
EGE1	blassexratio18	0.482	0.482	0.451	0.172
EGL1	blassexratio18	0.946	0.947	0.859	0.300
EGE42	blassexratio18	0.479	0.479	0.442	0.137
EGL42	blassexratio18	0.946	0.947	0.857	0.296
EGE46	blassexratio18	0.481	0.481	0.446	0.153
EGL46	blassexratio18	0.946	0.947	0.857	0.294
EGE64	blassexratio18	0.483	0.483	0.453	0.184
EGL64	blassexratio18	0.956	0.956	0.883	0.372
FGE1	blassexratio1844	0.484	0.479	0.322	0.110
FGL1	blassexratio1844	0.958	0.946	0.610	0.250
FGE51	blassexratio1844	0.484	0.479	0.323	0.111
FGL51	blassexratio1844	0.959	0.947	0.612	0.251
FGE61	blassexratio1844	0.484	0.479	0.323	0.111
FGL61	blassexratio1844	0.962	0.951	0.636	0.280
FGE64	blassexratio1844	0.484	0.479	0.318	0.105
FGL64	blassexratio1844	0.964	0.953	0.649	0.296

Finally, based on the theorized causal pathway, certain variables were considered as random slopes for each of the six sets of models (i.e., one set for each sex ratio of interest). Only ORs representing a one-unit change in the relevant sex ratio were considered. For sexratio0, sexratio18, sexratio1844, it was hypothesized that the relationship between HIV status and employment status varied across counties. Therefore, random slopes were tried for employment status when this variable was included in the relevant GLIMMIX models for these three sex ratios of interest. On the other hand, it was posited that, for blassexratio0, blassexratio18, and blassexratio1844, the relationship between housing status and employment status varied across counties. Therefore, random slopes were tried for housing status when this variable was included in the relevant GLIMMIX models for these three sex ratios of interest. For all GLIMMIX models run with random slopes, the convergence criterion was satisfied.

In Table 18, ORs and the corresponding 95% CI for a one-unit change in the sex ratio of interest are presented for the GLIMMIX model indicated. In no case did the inclusion of a random slope substantially alter the estimates for the sex ratio ORs or the corresponding 95% CIs. However, in all cases in which a random slope was included for employment status, it was statistically significant. Therefore, random slopes were retained in the relevant final models as indicated. On the other hand, none of the random slopes for housing status was significant and thus not retained in any of the final models.

Table 18. Odds Ratios for Sex Ratios of Interest Based on GLIMMIX Models Run with and without Random Slopes

model #	exposure	random slope	OR	95% CI, lower	95% CI, upper
AGL1	sexratio0	none	0.977	0.945	1.009
AGL1rs	sexratio0	newemploy	0.985	0.954	1.017
AGL30	sexratio0	none	0.976	0.942	1.012
AGL43	sexratio0	none	0.977	0.942	1.014
AGL64	sexratio0	none	0.975	0.936	1.017
BGL1	sexratio18	none	0.978	0.951	1.006
BGL1rs	sexratio18	newemploy	0.985	0.957	1.013
BGL18	sexratio18	none	0.978	0.950	1.008
BGL18rs	sexratio18	newemploy	0.985	0.956	1.014
BGL53	sexratio18	none	0.977	0.945	1.011
BGL64	sexratio18	none	0.977	0.942	1.013
CGL1	sexratio1844	none	0.978	0.951	1.005
CGL1rs	sexratio1844	newemploy	0.985	0.957	1.014
CGL43	sexratio1844	none	0.977	0.947	1.007
CGL53	sexratio1844	none	0.976	0.945	1.008
CGL64	sexratio1844	none	0.973	0.941	1.007
DGL1	blassexratio0	none	0.990	0.978	1.003
DGL1rs	blassexratio0	homeless	0.990	0.978	1.003
DGL47	blassexratio0	none	0.991	0.979	1.004
DGL47rs	blassexratio0	homeless	0.991	0.977	1.004
DGL62	blassexratio0	none	0.991	0.978	1.005
DGL62rs	blassexratio0	homeless	0.991	0.976	1.005
DGL64	blassexratio0	none	0.993	0.979	1.006
EGL1	blassexratio18	none	0.990	0.977	1.003
EGL1rs	blassexratio18	homeless	0.989	0.976	1.003
EGL42	blassexratio18	none	0.990	0.976	1.003
EGL46	blassexratio18	none	0.990	0.976	1.004
EGL46rs	blassexratio18	homeless	0.989	0.975	1.004
EGL64	blassexratio18	none	0.992	0.977	1.006
FGL1	blassexratio1844	none	0.989	0.974	1.004
FGL1rs	blassexratio1844	homeless	0.988	0.973	1.004
FGL51	blassexratio1844	none	0.989	0.973	1.005
FGL61	blassexratio1844	none	0.990	0.975	1.005
FGL64	blassexratio1844	none	0.990	0.973	1.007

Final Models

Based on the information presented above, a final GENMOD and GLIMMIX model was chosen for each sex ratio of interest (Table 19). Table 19 presents the model number, the sex ratio of interest, covariates, OR for the sex ratio of interest, and the corresponding 95% CI for each of the final models. Relevant SAS output is presented below Table 19 (Figure 1).

Although each of the models chosen contains at least one covariate other than exposure of interest, the "full" or "crude" model with or without random slopes could considered a suitable final model. Taking the information presented in Table 19 together with the information presented throughout the body of this report, it can be concluded that, in the particular populations and areas studied, as the sex ratio increases from more women relative to men to a relative balance between men and women to fewer women relative to men, the prevalence odds of HIV positivity decreases slightly. For the full, final, and reduced models calculated for the overall sex ratio for all ages, ORs for the sex ratio exposure ranged between 0.97 and 0.98, indicating that an increase in the sex ratio results in a slight decrease in the odds of being HIV-positive. None of these ORs was statistically significant. The OR range was the same for the full, final, and reduced GENMOD and GLIMMIX models for the overall sex ratios for the 18 years and older and the 18 to 44 years age groups. However, for the full GENMOD models for both of these groups and the reduced GENMOD model for the 18 to 44 years group, the POR was statistically significant. For the three black matched sex ratios, the PORs were slightly higher (range: 0.98 to 0.99) but still less than 1.0, indicating a similar relationship between the sex ratio and HIV status when calculated only for black men and women. For the black matched sex ratios, none of the ORs was statistically significant.

Table 19. Final GENMOD and GLIMMIX Models for Each Sex Ratio of Interest

model #	exposure	model covariates					random slope	OR	95% CI, lower	95% CI, upper
AGE43	sexratio0	agecat	newincome				**n/a**	0.972	0.929	1.017
AGL43	sexratio0	agecat	newincome				none	0.977	0.942	1.014
BGE53	sexratio18		newincome		homeless		**n/a**	0.972	0.940	1.005
BGL53	sexratio18		newincome		homeless		none	0.977	0.945	1.011
CGE53	sexratio1844		newincome		homeless		**n/a**	0.972	0.942	1.002
CGL53	sexratio1844		newincome		homeless		none	0.976	0.945	1.008
DGE62	blassexratio0				homeless		**n/a**	0.989	0.974	1.004
DGL62	blassexratio0				homeless		none	0.991	0.978	1.005
EGE46	blassexratio18			newemploy	homeless		**n/a**	1.015	0.964	1.008
EGL46	blassexratio18			newemploy	homeless		none	0.990	0.976	1.004
FGE51	blassexratio1844	agecat				f_mljail	**n/a**	0.983	0.957	1.010
FGL51	blassexratio1844	agecat				f_mljail	none	0.989	0.973	1.005

Figure 1. Relevant SAS Output for Final GENMOD and GLIMMIX Models

AGE43
Analysis Of GEE Parameter Estimates
Empirical Standard Error Estimates

Parameter	Estimate	Standard Error	95% Confidence Limits		Z	Pr > |Z|
Intercept	-1.9258	2.0930	-6.0280	2.1764	-0.92	0.3575
sexratio0	-0.0289	0.0231	-0.0741	0.0164	-1.25	0.2112
agecat	0.3146	0.0409	0.2344	0.3949	7.69	<.0001
newincome	0.2138	0.0554	0.1052	0.3224	3.86	0.0001

AGL43 - random intercept only
Solutions for Fixed Effects

Effect	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper
Intercept	-4.8248	0.2753	28	-17.52	<.0001	0.05	-5.3888	-4.2608
sexratio0CENT	-0.02298	0.01872	6694	-1.23	0.2195	0.05	-0.05967	0.01371
agecat	0.3643	0.05464	6694	6.67	<.0001	0.05	0.2572	0.4714
newincome	0.2358	0.06874	6694	3.43	0.0006	0.05	0.1011	0.3706

BGE53
Analysis Of GEE Parameter Estimates
Empirical Standard Error Estimates

Parameter	Estimate	Standard Error	95% Confidence Limits		Z	Pr > |Z|
Intercept	-1.2642	1.4678	-4.1409	1.6126	-0.86	0.3891
sexratio18	-0.0283	0.0171	-0.0619	0.0052	-1.66	0.0979
newincome	0.1764	0.0533	0.0719	0.2809	3.31	0.0009
homeless	0.2583	0.1411	-0.0182	0.5348	1.83	0.0671

BGL53 - random intercept only
Solutions for Fixed Effects

Effect	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper
Intercept	-3.7539	0.3108	27	-12.08	<.0001	0.05	-4.3916	-3.1163
sexratio18CENT	-0.02300	0.01725	6693	-1.33	0.1825	0.05	-0.05682	0.01082
newincome	0.1959	0.07083	6693	2.77	0.0057	0.05	0.05703	0.3347
homeless	0.2818	0.1734	6693	1.63	0.1041	0.05	-0.05809	0.6217

CGE53
Analysis Of GEE Parameter Estimates
Empirical Standard Error Estimates

Parameter	Estimate	Standard Error	95% Confidence Limits		Z	Pr > |Z|
Intercept	-1.0229	1.4910	-3.9452	1.8995	-0.69	0.4927
sexratio1844	-0.0285	0.0158	-0.0595	0.0024	-1.81	0.0709
newincome	0.1790	0.0550	0.0712	0.2868	3.26	0.0011
homeless	0.2561	0.1435	-0.0250	0.5373	1.79	0.0742

CGL53 - random intercept only
Solutions for Fixed Effects

Effect	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper
Intercept	-3.6134	0.3583	28	-10.08	<.0001	0.05	-4.3474	-2.8794
sexratio1844CENT	-0.02461	0.01650	6692	-1.49	0.1359	0.05	-0.05695	0.007739
newincome	0.1955	0.07064	6692	2.77	0.0057	0.05	0.05707	0.3340
homeless	0.2785	0.1745	6692	1.60	0.1105	0.05	-0.06358	0.6206

DGE62
Analysis Of GEE Parameter Estimates
Empirical Standard Error Estimates

Parameter	Estimate	Standard Error	95% Confidence Limits		Z	Pr > |Z|
Intercept	-2.3763	0.7580	-3.8619	-0.8907	-3.13	0.0017
blassexratio0	-0.0112	0.0077	-0.0263	0.0039	-1.46	0.1449
homeless	0.3289	0.1328	0.0687	0.5891	2.48	0.0132

DGL62 - random intercept only
Solutions for Fixed Effects

Effect	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper
Intercept	-3.5535	0.2698	28	-13.17	<.0001	0.05	-4.1061	-3.0010
blassexratio0CENT	-0.00897	0.006879	6773	-1.30	0.1921	0.05	-0.02246	0.004512
homeless	0.3647	0.1582	6773	2.30	0.0212	0.05	0.05453	0.6748

EGE46
Analysis Of GEE Parameter Estimates
Empirical Standard Error Estimates

Parameter	Estimate	Standard Error	95% Confidence Limits		Z	Pr > |Z|
Intercept	-2.9739	0.9615	-4.8584	-1.0893	-3.09	0.0020
blassexratio18	-0.0147	0.0113	-0.0369	0.0075	-1.30	0.1943
newemploy	0.5343	0.0819	0.3738	0.6948	6.52	<.0001
homeless	0.2202	0.1192	-0.0134	0.4538	1.85	0.0647

EGL46 - random intercept only
Solutions for Fixed Effects

Effect	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper
Intercept	-4.3232	0.2467	27	-17.52	<.0001	0.05	-4.8293	-3.8170
blassexratio18CENT	-0.01052	0.007153	6771	-1.47	0.1412	0.05	-0.02455	0.003497
newemploy	0.5905	0.09855	6771	5.99	<.0001	0.05	0.3973	0.7837
homeless	0.2176	0.1439	6771	1.51	0.1306	0.05	-0.06452	0.4998

FGE51
Analysis Of GEE Parameter Estimates
Empirical Standard Error Estimates

Parameter	Estimate	Standard Error	95% Confidence Limits		Z	Pr > |Z|
Intercept	-2.9739	0.9615	-4.8584	-1.0893	-3.09	0.0020
blassexratio18	-0.0147	0.0113	-0.0369	0.0075	-1.30	0.1943
newemploy	0.5343	0.0819	0.3738	0.6948	6.52	<.0001
homeless	0.2202	0.1192	-0.0134	0.4538	1.85	0.0647

FGL51 - random intercept only
Solutions for Fixed Effects

Effect	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper
Intercept	-4.2147	0.4279	27	-9.85	<.0001	0.05	-5.0926	-3.3368
blassexratio1844CENT	-0.01128	0.008285	6440	-1.36	0.1734	0.05	-0.02752	0.004961
agecat	0.3818	0.05575	6440	6.85	<.0001	0.05	0.2725	0.4911
F_MLJAIL	0.1415	0.1619	6440	0.87	0.3820	0.05	-0.1758	0.4588

REFERENCES

1. Centers for Disease Control and Prevention. HIV Surveillance Report, 2008. http://www.cdc.gov/hiv/topics/surveillance/resources/reports/. Accessed March 31, 2012.
2. Centers for Disease Control and Prevention. Characteristics associated with HIV infection among heterosexuals in urban areas with high AIDS prevalence - 24 cities, United States, 2006-2007. MMWR. 2011;60(31):1045-9.
3. Bureau of the Census. Statistical Abstract of the United States. http://www.census.gov/compendia/statab/cats/population.html. Accessed March 31, 2012.
4. DiNenno EA, Lansky A. What is the heterosexual risk of HIV? Developing a definition for the National HIV Behavioral Surveillance System. Unpublished. 2009.
5. Hallfors DD, Iritani BJ, Miller WC, Bauer DJ. Sexual and drug behavior patterns and HIV and STD racial disparities: the need for new directions. Am J Public Health. 2007;97(1):125-32.
6. Lane SD, Rubinstein RA, Keefe RH, Webster N, Cibula DA, Rosenthal A, et al. Structural violence and racial disparity in HIV transmission. J Health Care Poor Underserved. 2004;15(3):319-335.
7. Wyatt GE, Myers HF, Williams JK, Kitchen CR, Loeb T, Carmona JV, et al. Does a history of trauma contribute to HIV risk for women of color? Implications for prevention and policy. Am J Public Health. 2002;92(4):660-5.

8. Leichliter JS, Aral SO. Black women in the United States decrease their number of recent sex partners: temporal trends from the national survey of family growth. Sex Transm Dis. 2009;36(1):1-3.

9. Leichliter JS, Chesson HW, Sternberg M, Aral SO. The concentration of sexual behaviours in the USA: a closer examination of subpopulations. Sex Transm Infect. 2010;86 Suppl 3:45-51.

10. Tillerson K. Explaining racial disparities in HIV/AIDS incidence among women in the U.S.: a systematic review. Stat Med. 2008;27(20):4132-43.

11. El-Sadr WM, Mayer KH, Hodder SL. AIDS in America--forgotten but not gone. N Engl J Med. 2010;362(11):967-70.

12. Zierler S, Krieger N. Reframing women's risk: Social inequalities and HIV infection. Annu Rev Public Health. 1997;18:401-436.

13. Adimora AA, Schoenbach VJ. Social context, sexual networks, and racial disparities in rates of sexually transmitted infections. J Infect Dis. 2005;191 Suppl 1:S115-22.

14. Adimora AA, Schoenbach VJ, Doherty IA. HIV and African Americans in the southern United States: sexual networks and social context. Sex Transm Dis. 2006;33(7 Suppl):S39-45.

15. Adimora AA, Schoenbach VJ, Floris-Moore MA. Ending the epidemic of heterosexual HIV transmission among African Americans. Am J Prev Med. 2009;37(5):468-71.

16. Aral SO, Adimora AA, Fenton KA. Understanding and responding to disparities in HIV and other sexually transmitted infections in African Americans. Lancet. 2008;372(9635):337-40.

17. Harawa N, Adimora A. Incarceration, African Americans and HIV: advancing a research agenda. J Natl Med Assoc. 2008;100(1):57-62.

18. Lemelle AJ, Jr. Racialized social system and HIV infection: the case of African Americans. International Journal of Sociology and Social Policy. 2002;22(4-6):133-158.

19. Pouget ER, Kershaw TS, Niccolai LM, Ickovics JR, Blankenship KM. Associations of sex ratios and male incarceration rates with multiple opposite-sex partners: potential social determinants of HIV/STI transmission. Public Health Rep. 2010;125 Suppl 4:70-80.

20. Sanders-Phillips K. Factors influencing HIV/AIDS in women of color. Public Health Rep. 2002;117(3):S151-S156.

21. Cargill VA, Stone VE. HIV/AIDS: a minority health issue. Med Clin North Am. 2005;89(4):895-912.

22. Doherty IA, Leone PA, Aral SO. Social determinants of HIV infection in the Deep South. Am J Public Health. 2007;97(3):391.

23. Cooper HL, Friedman SR, Tempalski B, Friedman R. Residential segregation and injection drug use prevalence among Black adults in US metropolitan areas. Am J Public Health. 2007;97(2):344-52.

24. Thomas JC, Levandowski BA, Isler MR, Torrone E, Wilson G. Incarceration and sexually transmitted infections: A neighborhood perspective. J Urban Health. 2008;85(1):90-99.

25. Friedman SR, Cooper HLF, Osborne AH. Structural and social contexts of HIV risk among African Americans. Am J Public Health. 2009;99(6):1002-1008.

26. Adimora AA, Auerbach JD. Structural interventions for HIV prevention in the United States. J Acquir Immune Defic Syndr. 2010;55 Suppl 2:S132-5.

27. Higgins JA, Hoffman S, Dworkin SL. Rethinking gender, heterosexual men, and women's vulnerability to HIV/AIDS. Am J Public Health. 2010;100(3):435-45.

28. Ickovics J, Beren S, Grigorenko E, Morrill A, Druley J, Rodin J. Pathways of risk: race, social class, stress, and coping as factors predicting heterosexual risk behaviors for HIV among women. AIDS Behav. 2002;6:339-50.

29. Doyle R. Fewer men, more crime. Sci Am. 2005;293(5):32.

30. Adimora AA, Schoenbach VJ. Contextual factors and the black-white disparity in heterosexual HIV transmission. Epidemiology. 2002;13(6):707-712.

31. Senn TE, Carey MP, Vanable PA, Urban MA, Sliwinski MJ. The male-to-female ratio and multiple sexual partners: multilevel analysis with patients from an STD clinic. AIDS Behav. 2008;14(4):942-8.

32. Bontempi JM, Eng E, Quinn SC. Our men are grinding out: a qualitative examination of sex ratio imbalances, relationship power, and low-income African American women's health. Women Health. 2008;48(1):63-81.

33. Logan TK, Cole J, Leukefeld C. Women, sex, and HIV: social and contextual factors, meta-analysis of published interventions, and implications for practice and research. Psychol Bull. 2002;128(6):851-85.

34. Gouveia-Oliveira R, Pedersen AG. Higher variability in the number of sexual partners in males can contribute to a higher prevalence of sexually transmitted diseases in females. J Theor Biol. 2009;261(1):100-6.

35. Harris G, Mallory C, Stampley C. A qualitative study of man-sharing and the implications for midlife African American women's risk for HIV infection. Women Health. 2010;50(7):670-87.

36. Thomas JC, Sampson LA. High rates of incarceration as a social force associated with community rates of sexually transmitted infection. J Infect Dis. 2005;191 Suppl 1:S55-60.

37. Thomas JC, Gaffield ME. Social structure, race, and gonorrhea rates in the southeastern United States. Ethn Dis. 2003;13(3):362-8.

38. Kilmarx PH, Zaidi AA, Thomas JC, Nakashima AK, St Louis ME, Flock ML, et al. Sociodemographic factors and the variation in syphilis rates among US counties, 1984 through 1993: an ecological analysis. Am J Public Health. 1997;87(12):1937-43.

39. Gallagher KM, Sullivan PS, Lansky A, Onorato IM. Behavioral surveillance among people at risk for HIV infection in the U.S.: the National HIV Behavioral Surveillance System. Public Health Rep. 2007;122 Suppl 1:32-8.

40. Centers for Disease Control and Prevention. National HIV Behavioral Surveillance among Heterosexuals at Risk of HIV Infection (NHBS-HET): Model Surveillance Protocol: NCHHSTP/DHAP/BCSB/Behavioral Surveillance Team; 2006.

41. Bureau of the Census. An Overview of the American Community Survey. http://www.census.gov/acs/www/guidance_for_data_users/training_presentations/. Accessed March 31, 2012.

42. Kleinbaum DG, Klein M. Logistic Regression: A Self-Learning Text. Third ed. New York: Springer; 2010.

APPENDIX B

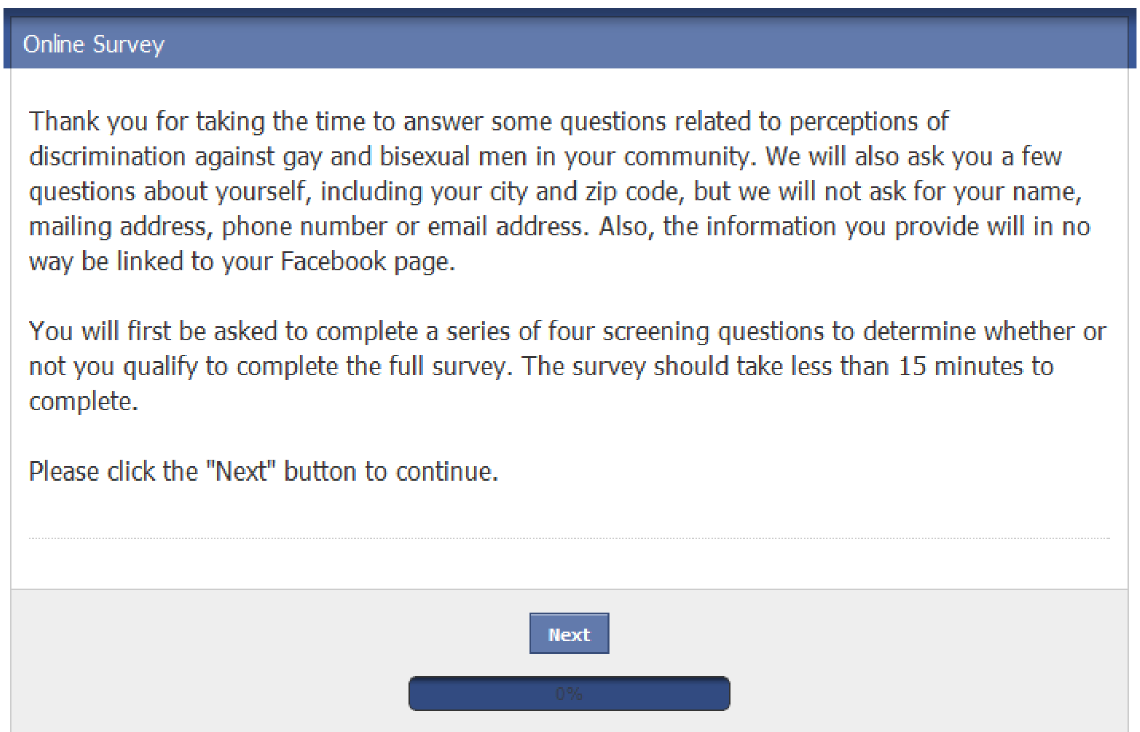
Survey of Perceived Discrimination against Gay and Bisexual Men

Survey Instrument as Hosted on surveygizmo.com

OVERVIEW

The following pages present “screen captures” of the entire survey instrument as it appeared no the survey hosting site, www.surveygizmo.com. The first page shown is what potential respondents saw when they clicked on one of the Facebook banner advertisements.

Figure 1. Page 1: Welcome


Online Survey

Thank you for taking the time to answer some questions related to perceptions of discrimination against gay and bisexual men in your community. We will also ask you a few questions about yourself, including your city and zip code, but we will not ask for your name, mailing address, phone number or email address. Also, the information you provide will in no way be linked to your Facebook page.

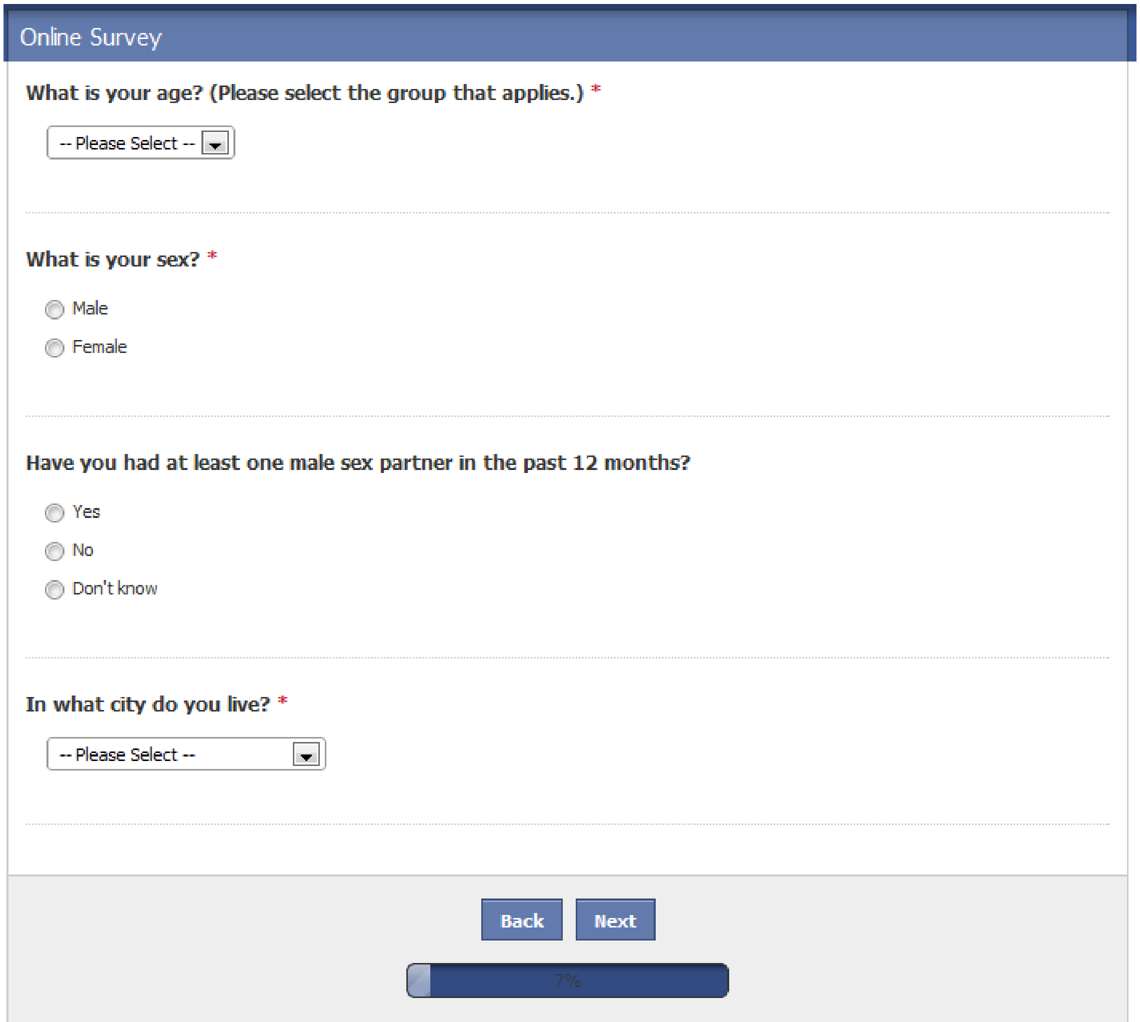
You will first be asked to complete a series of four screening questions to determine whether or not you qualify to complete the full survey. The survey should take less than 15 minutes to complete.

Please click the "Next" button to continue.

Next

0%

Figure 2. Page 2: Screenshot Questions



Online Survey

What is your age? (Please select the group that applies.) *

-- Please Select --

What is your sex? *

- Male
- Female

Have you had at least one male sex partner in the past 12 months?

- Yes
- No
- Don't know

In what city do you live? *

-- Please Select --

Back Next

7%

Figure 3. Page 3a: Qualification Notice

If a respondent qualified for the study based on his answers to the four screener questions, he was taken to this page.

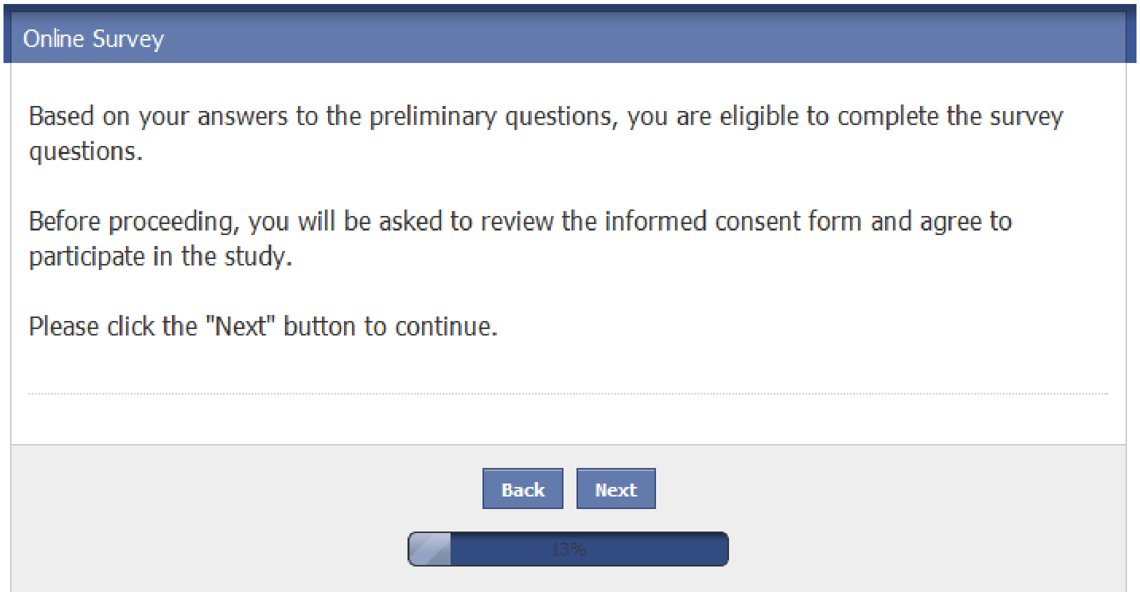


Figure 4. Page 3b: Disqualification Notice

If a respondent did not qualify for the study based on his answers to the four screener questions, he was taken to this page.

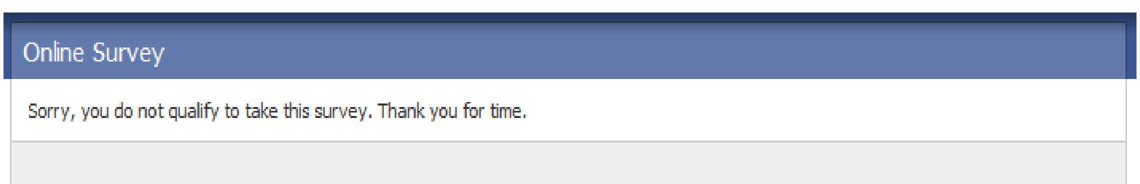
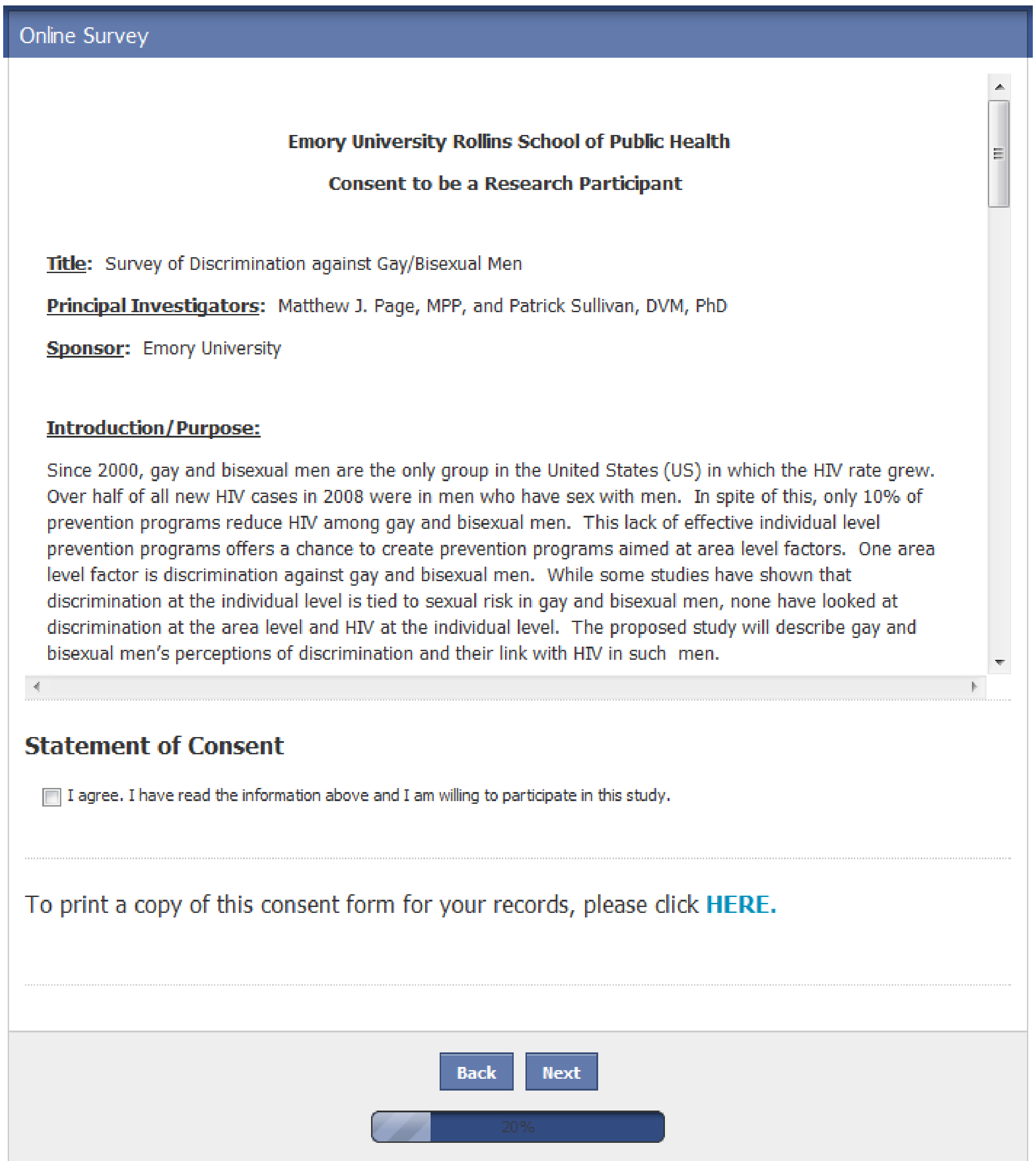


Figure 5. Page 4: Informed Consent

The entire informed consent form is not shown. Participants were required to use the scroll bar on the right side to view the entire form. They could click "HERE" at the bottom of the screen to view a PDF version of the form.



Online Survey

Emory University Rollins School of Public Health

Consent to be a Research Participant

Title: Survey of Discrimination against Gay/Bisexual Men

Principal Investigators: Matthew J. Page, MPP, and Patrick Sullivan, DVM, PhD

Sponsor: Emory University

Introduction/Purpose:

Since 2000, gay and bisexual men are the only group in the United States (US) in which the HIV rate grew. Over half of all new HIV cases in 2008 were in men who have sex with men. In spite of this, only 10% of prevention programs reduce HIV among gay and bisexual men. This lack of effective individual level prevention programs offers a chance to create prevention programs aimed at area level factors. One area level factor is discrimination against gay and bisexual men. While some studies have shown that discrimination at the individual level is tied to sexual risk in gay and bisexual men, none have looked at discrimination at the area level and HIV at the individual level. The proposed study will describe gay and bisexual men's perceptions of discrimination and their link with HIV in such men.

Statement of Consent

I agree. I have read the information above and I am willing to participate in this study.

To print a copy of this consent form for your records, please click **HERE.**

Back Next

20%

Figure 6. Page 5: Zip Code

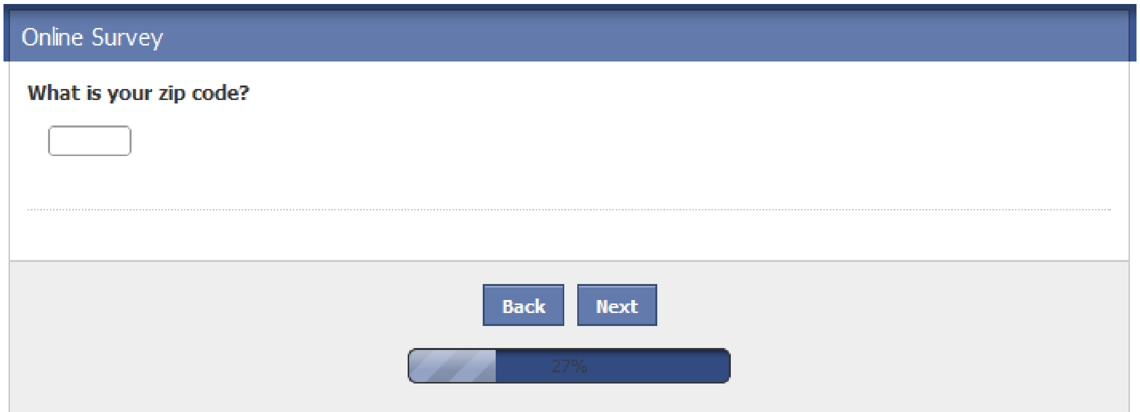


Figure 7. Page 6: Race

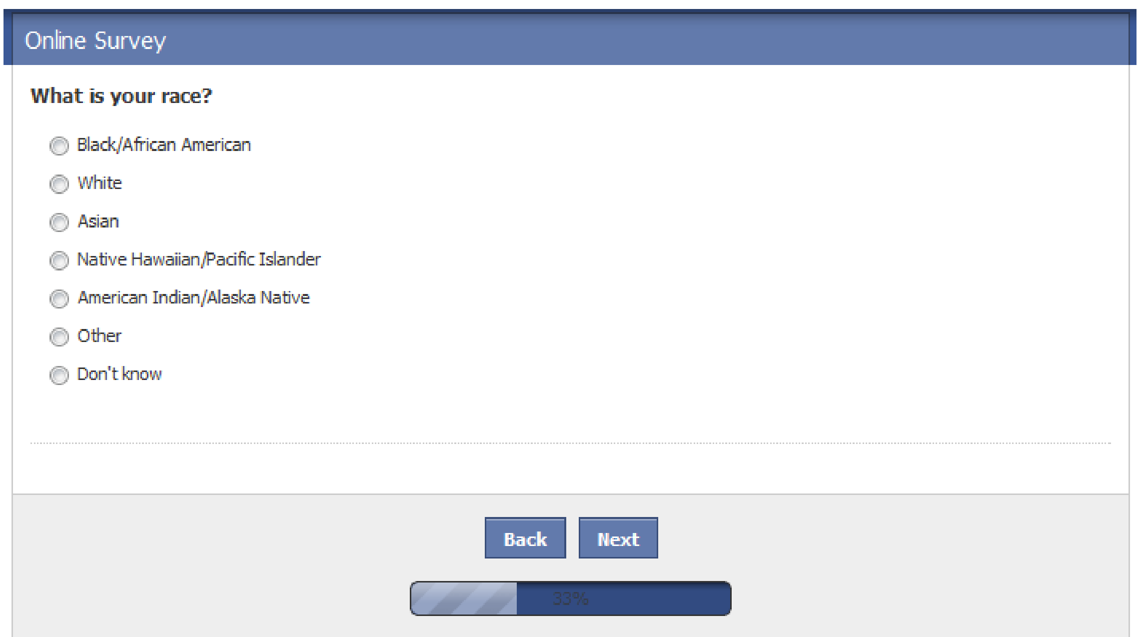


Figure 8. Page 7: Hispanic or Latino Ethnicity

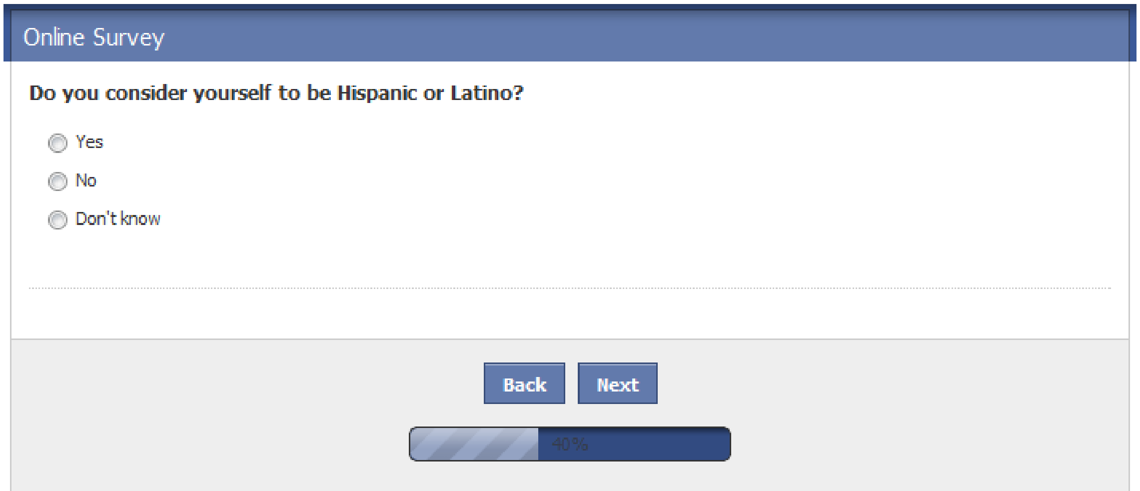
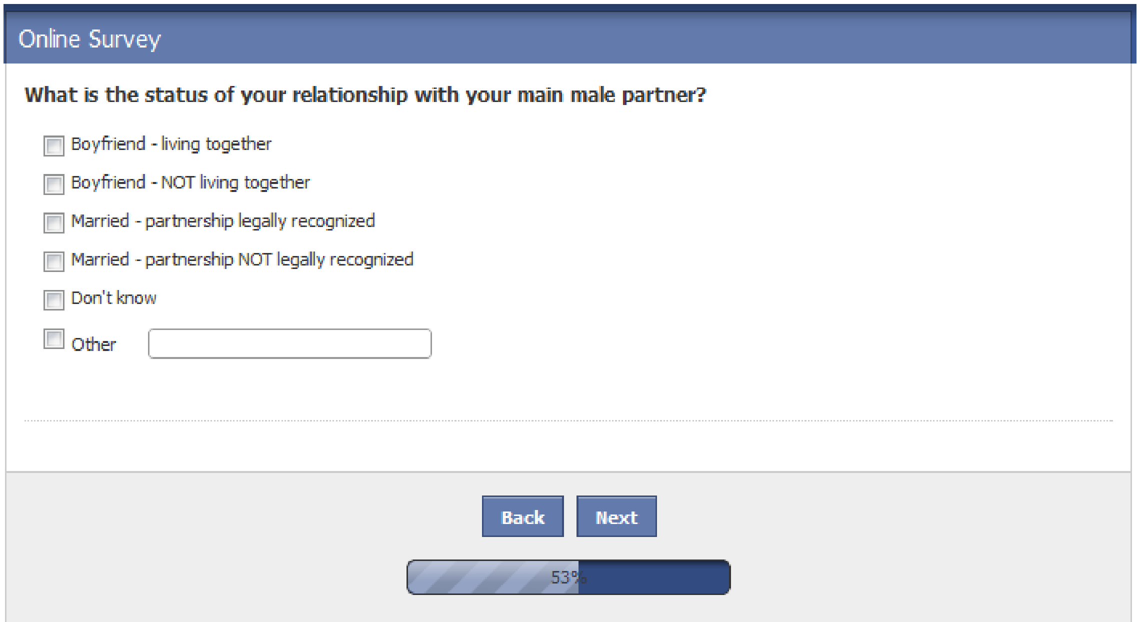


Figure 9. Page 8a: Main Male Partner

If a respondent answered "yes" to this question, he was taken to page 8b. If he answered "no" or "don't know," he was taken to page 9.

Figure 10. Page 8b: Main Male Partner – Relationship Status


Online Survey

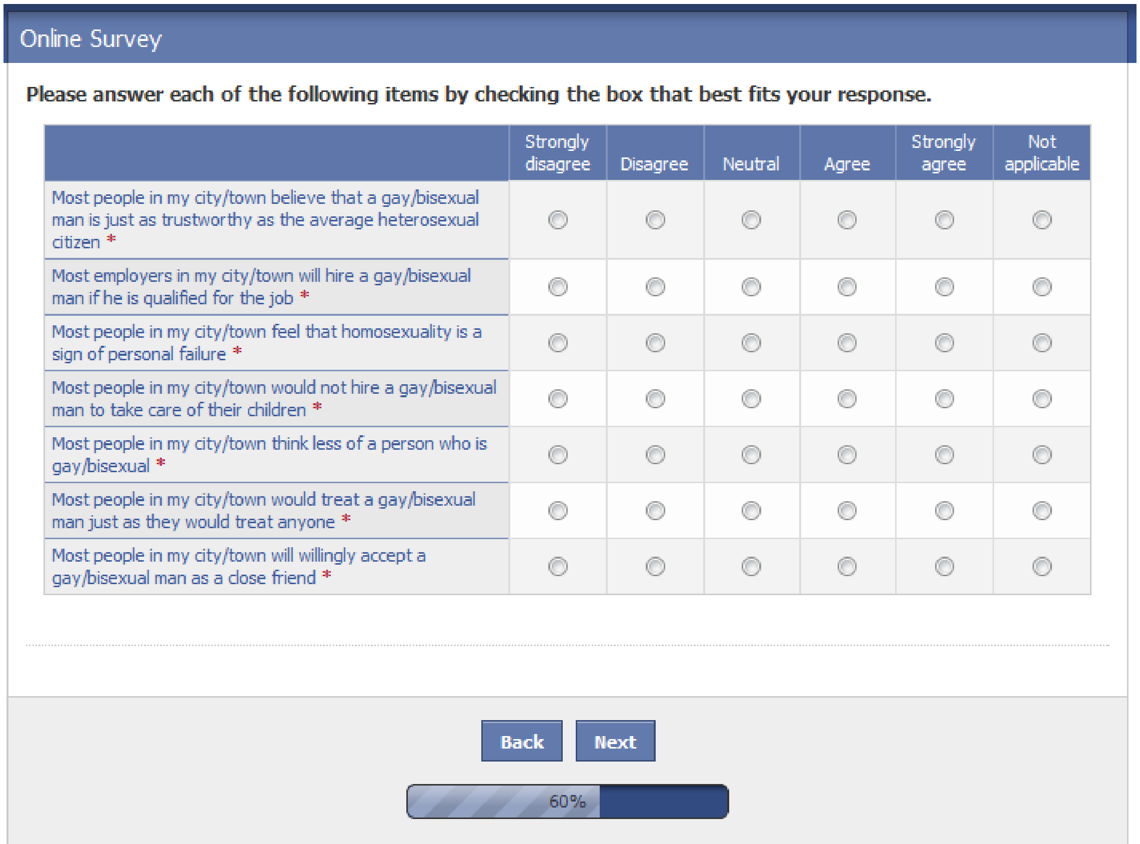
What is the status of your relationship with your main male partner?

- [ ] Boyfriend - living together
- [ ] Boyfriend - NOT living together
- [ ] Married - partnership legally recognized
- [ ] Married - partnership NOT legally recognized
- [ ] Don't know
- [ ] Other

Back Next

53%

Figure 11. Page 9: Perceived Discrimination Questions 1-7



Online Survey

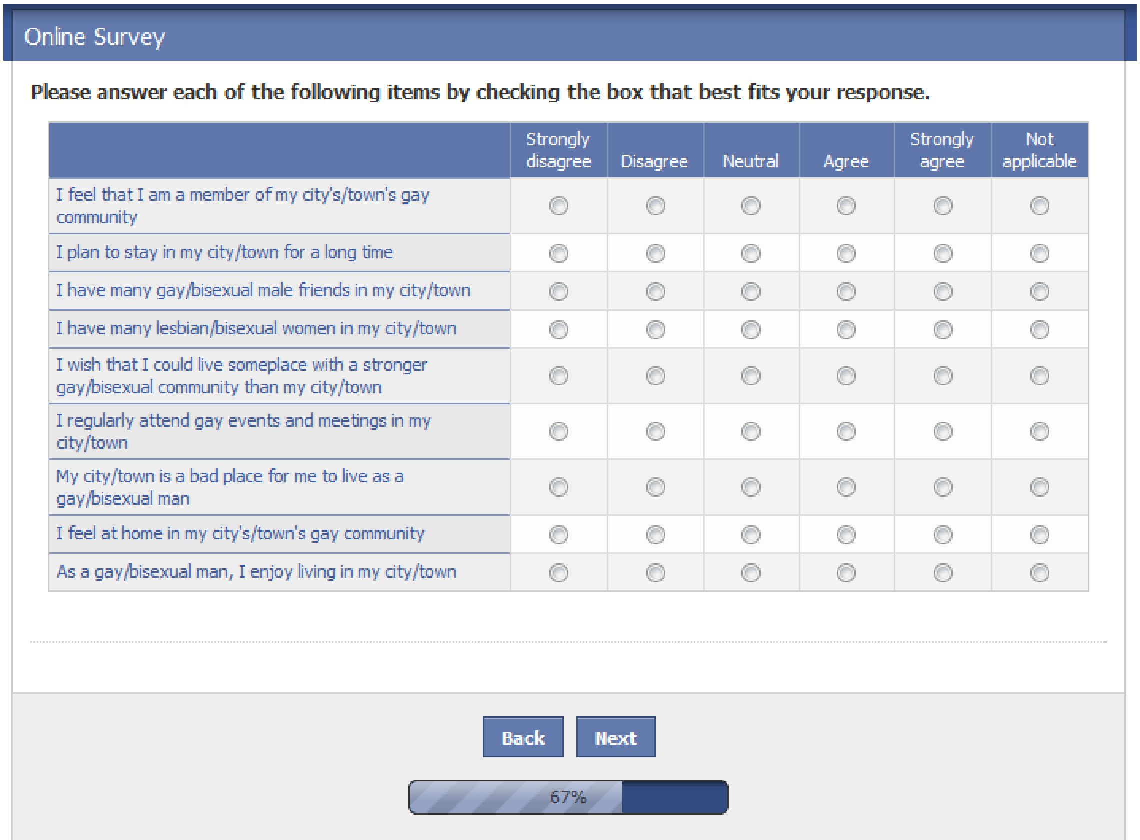
Please answer each of the following items by checking the box that best fits your response.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Not applicable
Most people in my city/town believe that a gay/bisexual man is just as trustworthy as the average heterosexual citizen *						
Most employers in my city/town will hire a gay/bisexual man if he is qualified for the job *						
Most people in my city/town feel that homosexuality is a sign of personal failure *						
Most people in my city/town would not hire a gay/bisexual man to take care of their children *						
Most people in my city/town think less of a person who is gay/bisexual *						
Most people in my city/town would treat a gay/bisexual man just as they would treat anyone *						
Most people in my city/town will willingly accept a gay/bisexual man as a close friend *						

Back Next

60%

Figure 12. Page 10: Perceived Discrimination Questions 9-16



Online Survey

Please answer each of the following items by checking the box that best fits your response.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Not applicable
I feel that I am a member of my city's/town's gay community	○	○	○	○	○	○
I plan to stay in my city/town for a long time	○	○	○	○	○	○
I have many gay/bisexual male friends in my city/town	○	○	○	○	○	○
I have many lesbian/bisexual women in my city/town	○	○	○	○	○	○
I wish that I could live someplace with a stronger gay/bisexual community than my city/town	○	○	○	○	○	○
I regularly attend gay events and meetings in my city/town	○	○	○	○	○	○
My city/town is a bad place for me to live as a gay/bisexual man	○	○	○	○	○	○
I feel at home in my city's/town's gay community	○	○	○	○	○	○
As a gay/bisexual man, I enjoy living in my city/town	○	○	○	○	○	○

Back Next

67%

Figure 13. Page 11: City of Residence Four Years Ago

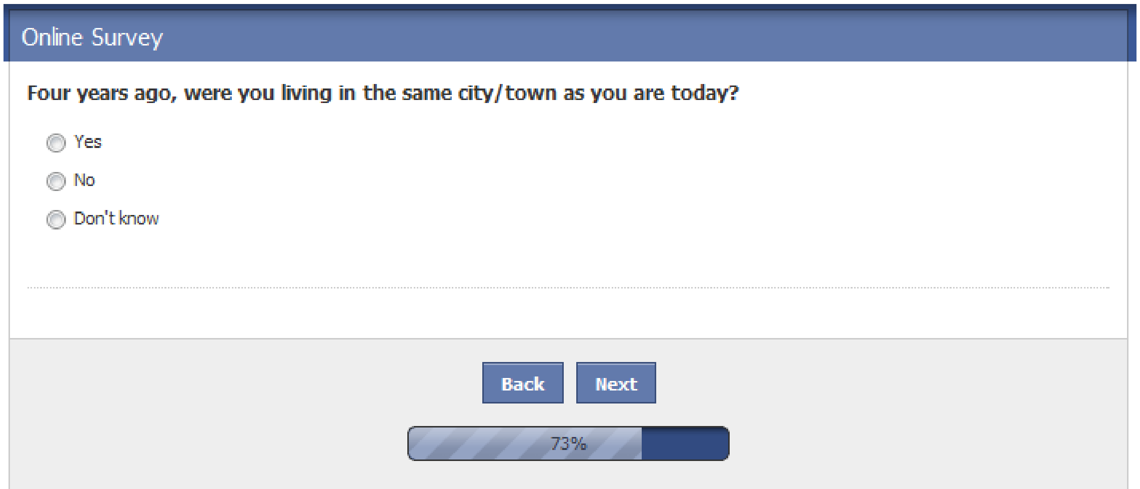


Figure 14. Page 12: Prompt for Questions about Perceived Discrimination Four Years Ago

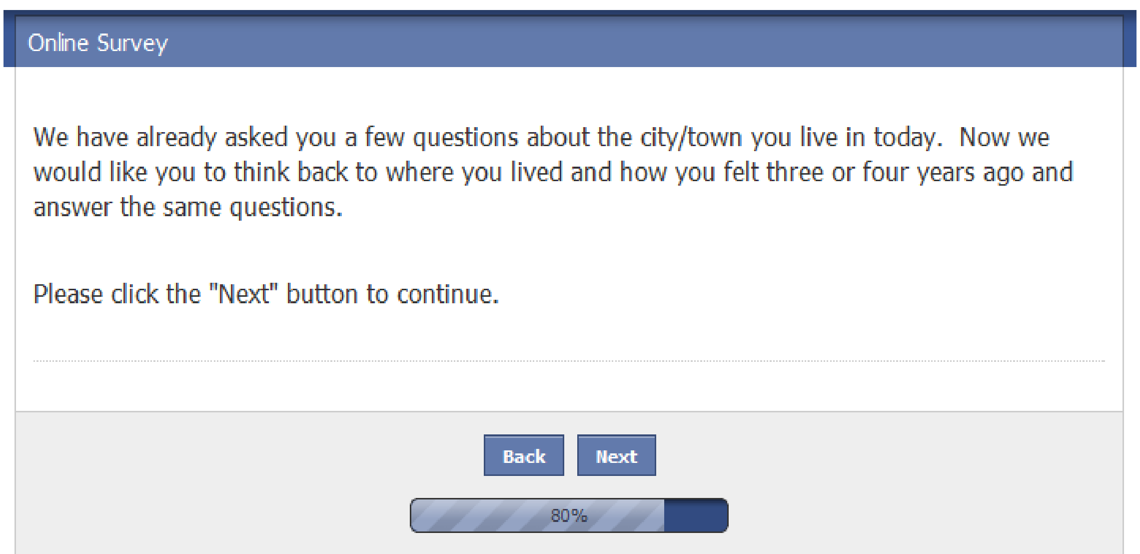
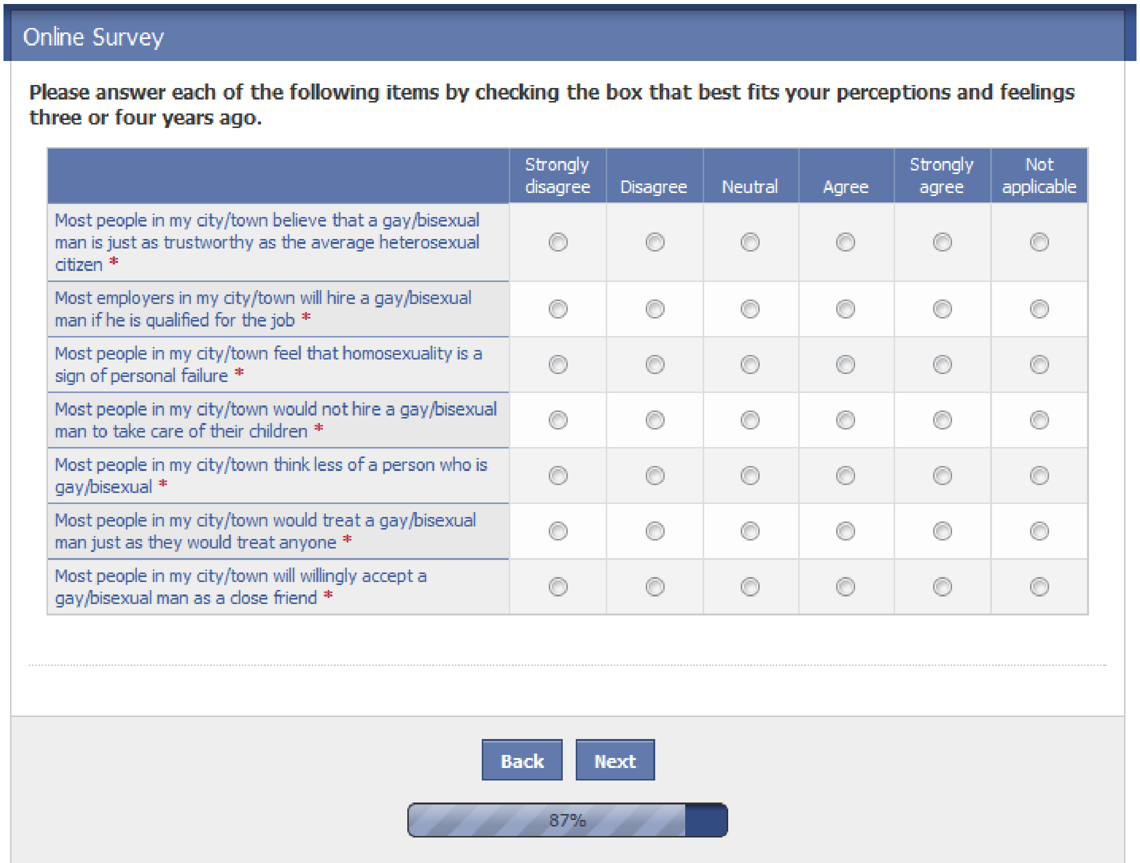


Figure 15. Page 13: Perceived Discrimination Four Years Ago Questions 1-7



Online Survey

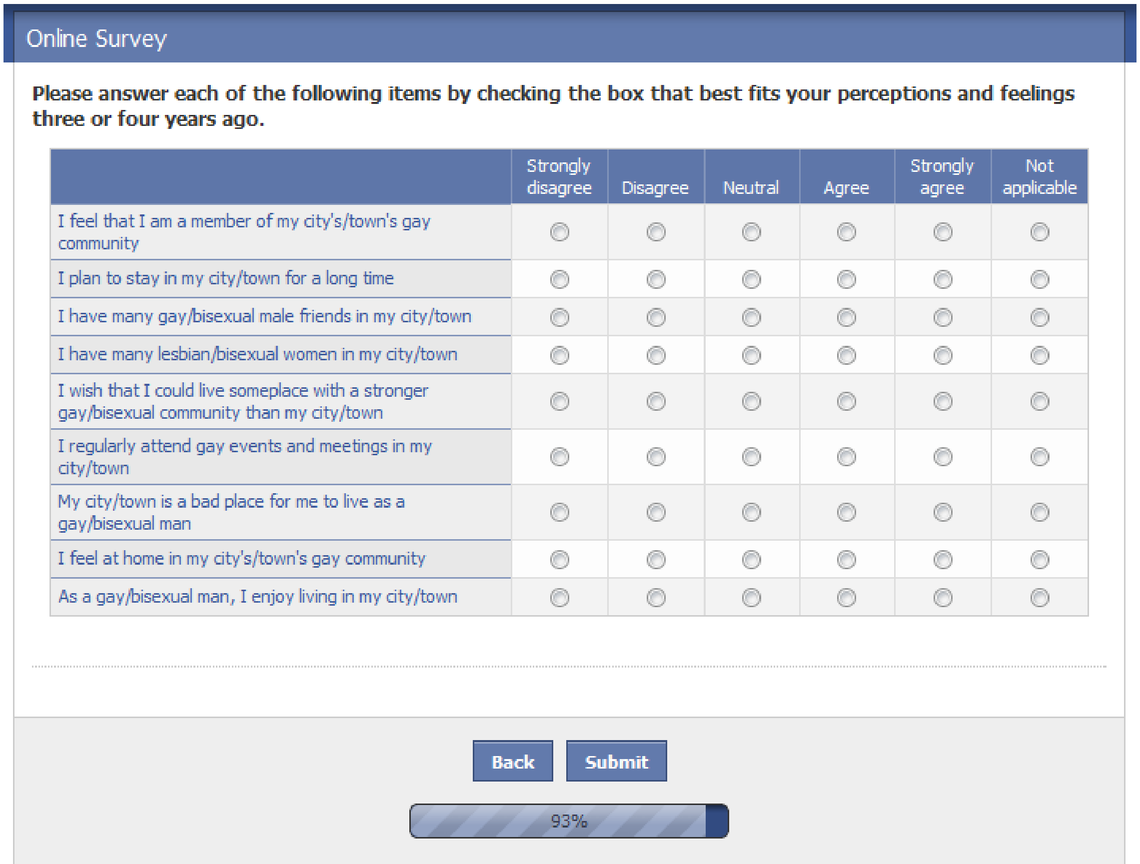
Please answer each of the following items by checking the box that best fits your perceptions and feelings three or four years ago.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Not applicable
Most people in my city/town believe that a gay/bisexual man is just as trustworthy as the average heterosexual citizen *						
Most employers in my city/town will hire a gay/bisexual man if he is qualified for the job *						
Most people in my city/town feel that homosexuality is a sign of personal failure *						
Most people in my city/town would not hire a gay/bisexual man to take care of their children *						
Most people in my city/town think less of a person who is gay/bisexual *						
Most people in my city/town would treat a gay/bisexual man just as they would treat anyone *						
Most people in my city/town will willingly accept a gay/bisexual man as a close friend *						

Back Next

87%

Figure 16. Page 14: Perceived Discrimination Four Years Ago Questions 9-16



Online Survey

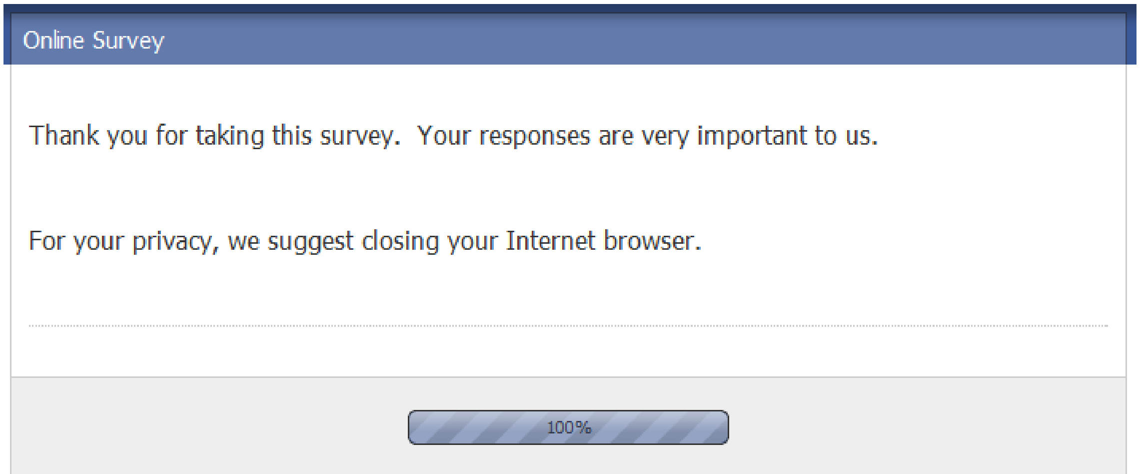
Please answer each of the following items by checking the box that best fits your perceptions and feelings three or four years ago.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Not applicable
I feel that I am a member of my city's/town's gay community						
I plan to stay in my city/town for a long time						
I have many gay/bisexual male friends in my city/town						
I have many lesbian/bisexual women in my city/town						
I wish that I could live someplace with a stronger gay/bisexual community than my city/town						
I regularly attend gay events and meetings in my city/town						
My city/town is a bad place for me to live as a gay/bisexual man						
I feel at home in my city's/town's gay community						
As a gay/bisexual man, I enjoy living in my city/town						

Back Submit

93%

Figure 17. Page 15: Thank You



APPENDIX C

Survey of Perceived Discrimination against Gay and Bisexual Men

Facebook Advertising

OVERVIEW

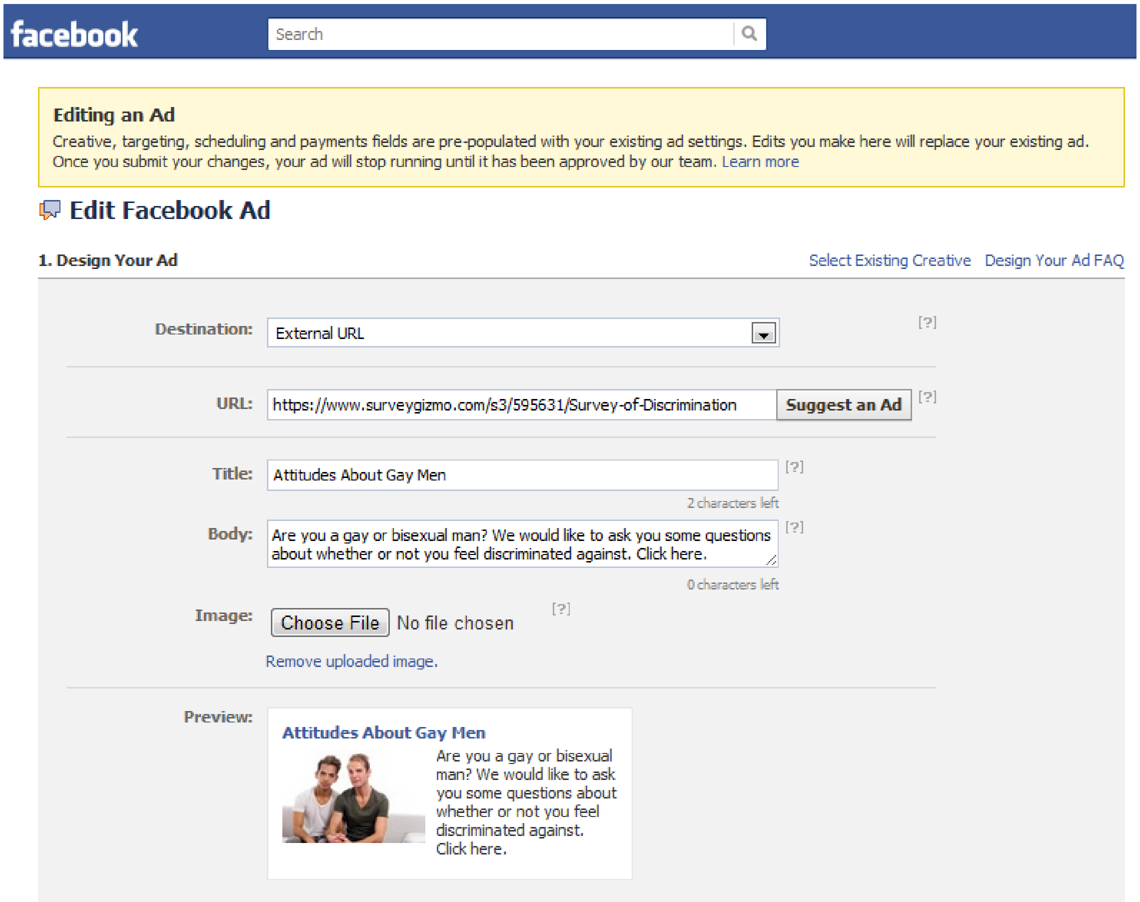
"Screen captures" of the Facebook advertisement editing and targeting process, the Facebook ad manager, and a full report on the advertising conducted during the timeframe when the survey was live (November 4, 2011, to January 8, 2012) are presented on the following pages. Some of the screen captures were modified to fit on the pages. All germane information is presented.

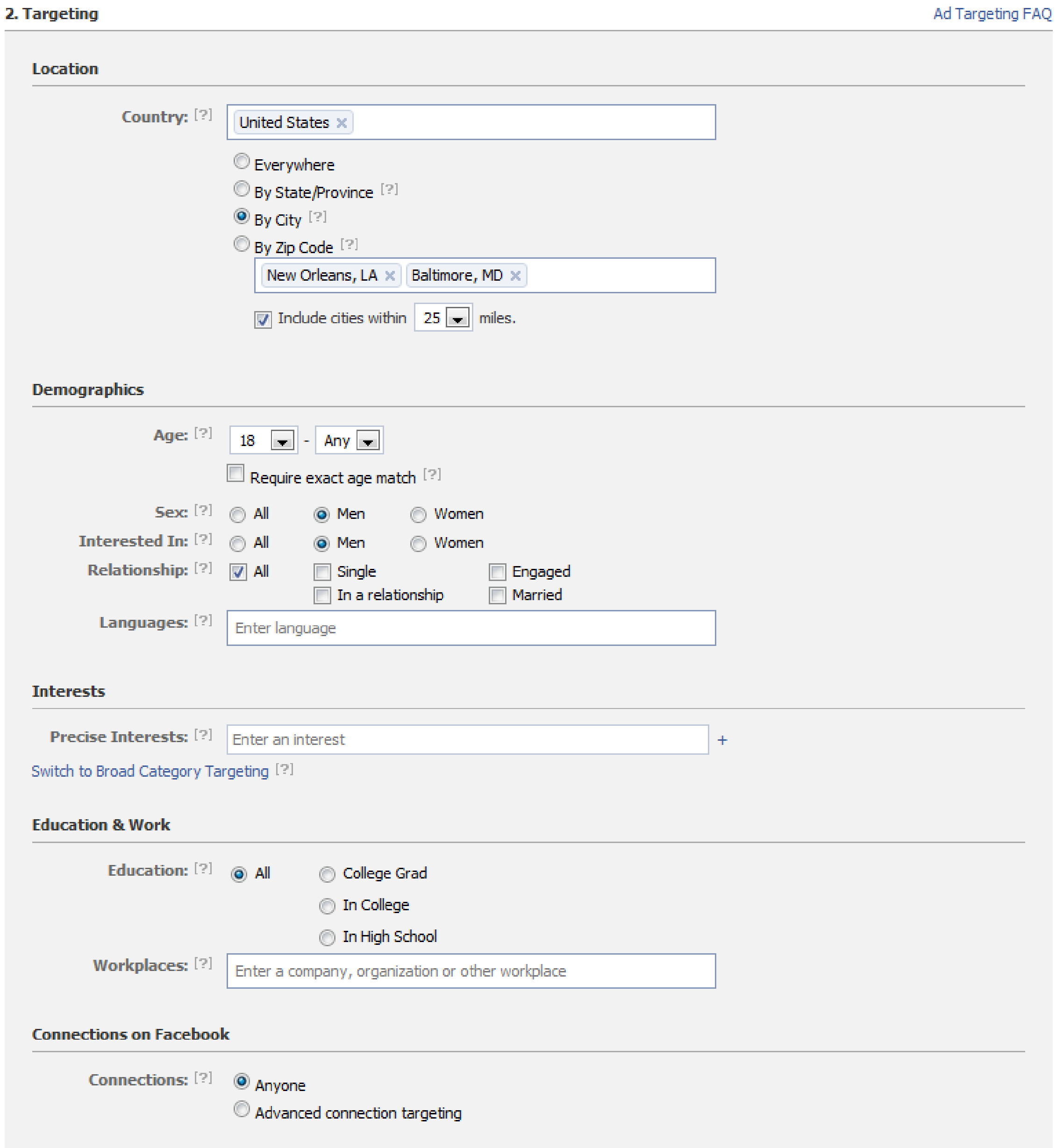
The first three pages show how a Facebook advertisement is designed, edited, and targeted. This process is stratified into three steps – (1) Design; (2) Targeting, and (3) Pricing and Scheduling. For this example, Advertisement #5 ("Attitudes About Gay Men") is shown.

The fourth page shows the advertising statistics for the week of December 27, 2011, through January 2, 2012. During this week, Advertisement #5 reached 14,723 individuals, with the average individual seeing this ad 11.1 times. This advertisement received 146 clicks during the week for a click-through rate (CTR) of 0.089%. The CTR is calculated as the number of clicks divided by the number of times the ad was shown. While \$0.89 was bid per click for this advertisement, the actual cost per click was \$0.72.

The final page presents the full Facebook advertising report for the study. All survey advertisements garnered 10,356,873 impressions and 6,751 clicks. This translates to an overall CTR of 0.065%. and an overall cost per click of $0.62. Considering that there were 1,628 useable survey responses, the overall cost per useable response was $2.55.

Figure 1. Designing, Targeting, and Editing a Facebook Advertisement




2. Targeting
Ad Targeting FAQ
Location
Country: [?]
United States
Everywhere
By State/Province [?]
By City [?]
By Zip Code [?]
New Orleans, LA
Baltimore, MD
Include cities within 25 miles.
Demographics
Age: [?]
18 - Any
Require exact age match [?]
Sex: [?] All Men Women
Interested In: [?] All Men Women
Relationship: [?] All Single Engaged
In a relationship Married
Languages: [?]
Enter language
Interests
Precise Interests: [?]
Enter an interest
Switch to Broad Category Targeting [?]
Education & Work
Education: [?] All College Grad
In College
In High School
Workplaces: [?]
Enter a company, organization or other workplace
Connections on Facebook
Connections: [?]
Anyone
Advanced connection targeting

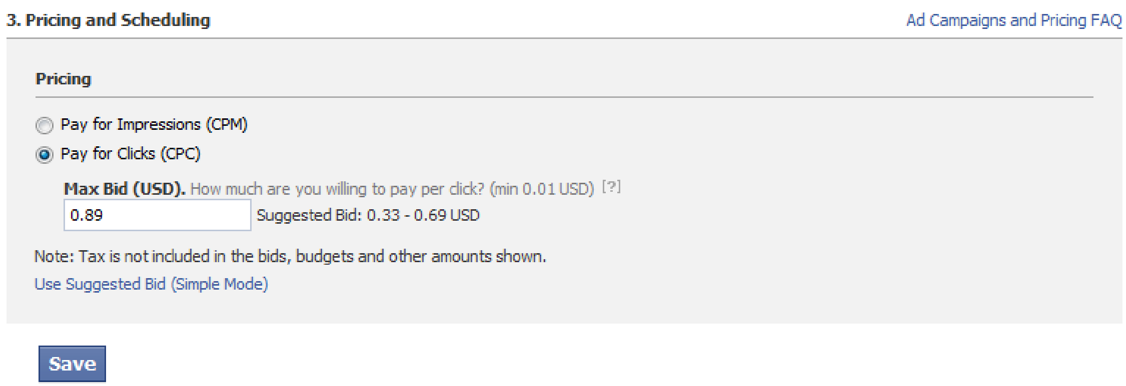

3. Pricing and Scheduling
Ad Campaigns and Pricing FAQ
Pricing
Pay for Impressions (CPM)
Pay for Clicks (CPC)
Max Bid (USD). How much are you willing to pay per click? (min 0.01 USD) [?]
0.89
Suggested Bid: 0.33 - 0.69 USD
Note: Tax is not included in the bids, budgets and other amounts shown.
Use Suggested Bid (Simple Mode)
Save

Figure 2. Facebook Advertising Manager, Week of December 27, 2011-January 2, 2012

facebook

Name	Campaign	Status	Reach	Freq.	Clicks	CTR	Bid	Price
Attitudes About Gay Men	Survey of Discrimination Ad #5		14,723	11.1	146	0.089%	$0.89 CPC	$0.72 CPC
Discrimination Survey	Survey of Discrimination Ad #7		12,156	10.8	81	0.062%	$1.05 CPC	$0.86 CPC
Emory University Survey	Survey of Discrimination Ad #8		18,147	11.8	131	0.061%	$1.02 CPC	$0.80 CPC
Survey of Discrimination	Survey of Discrimination Ad #3		14,368	10.9	86	0.055%	$0.98 CPC	$0.79 CPC
Survey of Discrimination	Survey of Discrimination Ad #4		10,470	10.8	54	0.048%	$1.08 CPC	$0.94 CPC
Discrimination Survey	Survey of Discrimination Ad #6		6,611	8.7	26	0.045%	$1.07 CPC	$0.92 CPC
Attitudes About Gay Men	Survey of Discrimination Ad #9		0	0.0	0	0.000%	$0.50 CPC	$0.00 CPC
Survey of Discrimination	Survey of Discrimination Ad #1		0	0.0	0	0.000%	$0.55 CPC	$0.00 CPC
Survey of Discrimination	Survey of Discrimination Ad #2		0	0.0	0	0.000%	$0.60 CPC	$0.00 CPC

Figure 3. Facebook Advertising: Full Report

facebook

10,356,873 Impressions 6,751 Clicks 0 Connections 0.065% CTR $4,157.99 Spent $0.40 CPM $0.62 CPC

Date Range ?	Campaign ?	Impressions ?	Clicks ?	CTR ?	CPC ?	CPM ?	Spent ?
Lifetime	Survey of Discrimination Ad #1	1,989,596	1,446	0.073%	0.56	0.40	804.46
Lifetime	Survey of Discrimination Ad #2	1,851,886	1,317	0.071%	0.62	0.44	810.56
Lifetime	Survey of Discrimination Ad #3	1,174,308	558	0.048%	0.73	0.35	405.75
Lifetime	Survey of Discrimination Ad #4	1,223,098	629	0.051%	0.76	0.39	475.48
Lifetime	Survey of Discrimination Ad #6	690,615	403	0.058%	0.64	0.37	257.26
Lifetime	Survey of Discrimination Ad #5	1,412,068	1,235	0.087%	0.53	0.46	651.74
Lifetime	Survey of Discrimination Ad #7	789,013	448	0.057%	0.67	0.38	300.19
Lifetime	Survey of Discrimination Ad #8	1,189,092	699	0.059%	0.64	0.37	445.45
Lifetime	Survey of Discrimination Ad #9	37,197	16	0.043%	0.44	0.19	7.10

APPENDIX D

Association of Perceived Discrimination against Gay and Bisexual Men with HIV Status among Men who Have Sex with Men in the United States

Confounding and Precision Assessment

TABLES OF ODDS RATIOS

A series of GENMOD and GLIMMIX models including all possible combinations of covariates (i.e., all variables other than the exposure of interest) were run. GLIMMIX models were run with only a random intercept. Tables 1-4 present odds ratios (ORs) for a one-unit change in the overall and partial measures of perceived discrimination against gay and bisexual men based on two sets of GENMOD models and two sets of GLIMMIX models.

The tables are presented in two pairs. While the first table in each pair shows ORs calculated for the discrimination measure of interest based on the relevant GENMOD model, the second table shows ORs calculated based on the relevant GLIMMIX model. The first row of each table shows the “full” model (i.e., all variables included). The last row of each table presents the “reduced” model (i.e., only the exposure of interest included). The intervening rows depict models based on all possible combinations of covariates.

The first column of each table shows the model number. The second column of each table presents the exposure of interest. The next six columns show the covariates included in each particular model. Next are the OR for the exposure and its corresponding 95% confidence interval (CI).

Table 1. GENMOD Model Odds Ratios for Overall Perceived Discrimination

model #	exposure	model covariates						OR	95% CI, lower	95% CI, upper
AGE1	PDall	agecat	newrace	newincome	newemploy2	niuse12	outother	0.982	0.950	1.015
AGE2	PDall	agecat	newrace	newincome	newemploy2	niuse12		0.974	0.943	1.007
AGE3	PDall	agecat	newrace	newincome	newemploy2		outother	0.978	0.944	1.014
AGE4	PDall	agecat	newrace	newincome		niuse12	outother	0.983	0.949	1.019
AGE5	PDall	agecat	newrace		newemploy2	niuse12	outother	0.985	0.951	1.021
AGE6	PDall	agecat		newincome	newemploy2	niuse12	outother	0.990	0.958	1.023
AGE7	PDall		newrace	newincome	newemploy2	niuse12	outother	0.995	0.963	1.028
AGE8	PDall			newincome	newemploy2	niuse12	outother	1.003	0.970	1.036
AGE9	PDall	agecat			newemploy2	niuse12	outother	0.998	0.961	1.035
AGE10	PDall	agecat	newrace			niuse12	outother	0.986	0.948	1.026
AGE11	PDall	agecat	newrace	newincome			outother	0.981	0.943	1.020
AGE12	PDall	agecat	newrace	newincome	newemploy2			0.970	0.936	1.004
AGE13	PDall		newrace		newemploy2	niuse12	outother	0.994	0.961	1.029
AGE14	PDall		newrace	newincome		niuse12	outother	1.005	0.970	1.041
AGE15	PDall		newrace	newincome	newemploy2		outother	0.991	0.959	1.025
AGE16	PDall		newrace	newincome	newemploy2	niuse12		0.990	0.959	1.021
AGE17	PDall	agecat		newincome		niuse12	outother	0.994	0.960	1.030
AGE18	PDall	agecat		newincome	newemploy2		outother	0.986	0.951	1.021
AGE19	PDall	agecat		newincome	newemploy2	niuse12		0.982	0.951	1.013
AGE20	PDall	agecat	newrace		newemploy2		outother	0.981	0.944	1.018
AGE21	PDall	agecat	newrace		newemploy2	niuse12		0.977	0.943	1.011
AGE22	PDall	agecat	newrace	newincome		niuse12		0.977	0.943	1.011

AGE23	PDall				newemploy2	niuse12	outother	1.005	0.970	1.041
AGE24	PDall	agecat				niuse12	outother	1.004	0.961	1.048
AGE25	PDall	agecat	newrace				outother	0.982	0.941	1.025
AGE26	PDall	agecat	newrace	newincome				0.973	0.937	1.011
AGE27	PDall			newincome		niuse12	outother	1.016	0.980	1.053
AGE28	PDall			newincome	newemploy2		outother	0.998	0.966	1.032
AGE29	PDall			newincome	newemploy2	niuse12		0.996	0.966	1.028
AGE30	PDall		newrace			niuse12	outother	1.003	0.966	1.041
AGE31	PDall		newrace		newemploy2		outother	0.989	0.955	1.024
AGE32	PDall		newrace		newemploy2	niuse12		0.989	0.957	1.022
AGE33	PDall		newrace	newincome			outother	1.003	0.967	1.039
AGE34	PDall		newrace	newincome		niuse12		1.000	0.967	1.034
AGE35	PDall		newrace	newincome	newemploy2			0.986	0.955	1.018
AGE36	PDall	agecat			newemploy2		outother	0.992	0.954	1.031
AGE37	PDall	agecat			newemploy2	niuse12		0.988	0.955	1.023
AGE38	PDall	agecat		newincome			outother	0.991	0.953	1.031
AGE39	PDall	agecat		newincome		niuse12		0.986	0.954	1.020
AGE40	PDall	agecat		newincome	newemploy2			0.976	0.943	1.010
AGE41	PDall	agecat	newrace			niuse12		0.978	0.941	1.017
AGE42	PDall	agecat	newrace		newemploy2			0.971	0.936	1.007
AGE43	PDall	agecat	newrace					0.973	0.933	1.015
AGE44	PDall		newrace	newincome				0.998	1.038	1.033
AGE45	PDall			newincome	newemploy2			0.992	0.961	1.024
AGE46	PDall				newemploy2	niuse12		0.995	0.963	1.028
AGE47	PDall					niuse12	outother	1.019	0.979	1.061
AGE48	PDall	agecat		newincome				0.983	0.946	1.021
AGE49	PDall	agecat			newemploy2			0.982	0.946	1.018

AGE50	PDall	agecat				niuse12		0.997	0.957	1.038
AGE51	PDall	agecat					outother	1.000	0.953	1.049
AGE52	PDall		newrace		newemploy2			0.983	0.951	1.016
AGE53	PDall		newrace			niuse12		0.998	0.963	1.035
AGE54	PDall		newrace				outother	0.999	0.960	1.038
AGE55	PDall			newincome		niuse12		1.009	0.976	1.044
AGE56	PDall			newincome			outother	1.013	0.976	1.051
AGE57	PDall				newemploy2		outother	0.999	0.963	1.035
AGE58	PDall	agecat						0.992	0.948	1.038
AGE59	PDall		newrace					0.994	0.957	1.032
AGE60	PDall			newincome				1.006	0.972	1.042
AGE61	PDall				newemploy2			0.992	0.959	1.026
AGE62	PDall					niuse12		1.014	0.976	1.054
AGE63	PDall						outother	1.014	0.972	1.058
AGE64	PDall							1.009	0.969	1.051

Table 2. GLIMMIX Model Odds Ratios for Overall Perceived Discrimination

model #	exposure	model covariates						OR	95% CI, lower	95% CI, upper
AGL1	PDall	agecat	newrace	newincome	newemploy2	niuse12	outother	0.990	0.958	1.024
AGL2	PDall	agecat	newrace	newincome	newemploy2	niuse12		0.989	0.957	1.022
AGL3	PDall	agecat	newrace	newincome	newemploy2		outother	0.987	0.954	1.022
AGL4	PDall	agecat	newrace	newincome		niuse12	outother	0.990	0.956	1.025
AGL5	PDall	agecat	newrace		newemploy2	niuse12	outother	0.997	0.964	1.031
AGL6	PDall	agecat		newincome	newemploy2	niuse12	outother	0.997	0.961	1.035
AGL7	PDall		newrace	newincome	newemploy2	niuse12	outother	0.991	0.956	1.027
AGL8	PDall			newincome	newemploy2	niuse12	outother	0.995	0.959	1.032
AGL9	PDall	agecat			newemploy2	niuse12	outother	1.007	0.970	1.046
AGL10	PDall	agecat	newrace			niuse12	outother	0.999	0.964	1.035
AGL11	PDall	agecat	newrace	newincome			outother	0.987	0.952	1.023
AGL12	PDall	agecat	newrace	newincome	newemploy2			0.986	0.953	1.020
AGL13	PDall		newrace		newemploy2	niuse12	outother	0.995	0.959	1.032
AGL14	PDall		newrace	newincome		niuse12	outother	0.991	0.955	1.029
AGL15	PDall		newrace	newincome	newemploy2		outother	0.989	0.953	1.025
AGL16	PDall		newrace	newincome	newemploy2	niuse12		0.990	0.956	1.025
AGL17	PDall	agecat		newincome		niuse12	outother	0.997	0.960	1.036
AGL18	PDall	agecat		newincome	newemploy2		outother	0.994	0.958	1.032
AGL19	PDall	agecat		newincome	newemploy2	niuse12		0.996	0.961	1.032
AGL20	PDall	agecat	newrace		newemploy2		outother	0.994	0.959	1.029
AGL21	PDall	agecat	newrace		newemploy2	niuse12		0.995	0.962	1.028
AGL22	PDall	agecat	newrace	newincome		niuse12		0.989	0.956	1.023

AGL23	PDall				newemploy2	niuse12	outother	1.002	0.965	1.493
AGL24	PDall	agecat				niuse12	outother	1.011	0.971	1.052
AGL25	PDall	agecat	newrace				outother	0.996	0.959	1.034
AGL26	PDall	agecat	newrace	newincome				0.986	0.951	1.022
AGL27	PDall			newincome		niuse12	outother	0.996	0.958	1.034
AGL28	PDall			newincome	newemploy2		outother	0.993	0.957	1.031
AGL29	PDall			newincome	newemploy2	niuse12		0.994	0.959	1.030
AGL30	PDall		newrace			niuse12	outother	0.998	0.960	1.036
AGL31	PDall		newrace		newemploy2		outother	0.993	0.957	1.030
AGL32	PDall		newrace		newemploy2	niuse12		0.994	0.959	1.030
AGL33	PDall		newrace	newincome			outother	0.989	0.952	1.023
AGL34	PDall		newrace	newincome		niuse12		0.990	0.955	1.027
AGL35	PDall		newrace	newincome	newemploy2			0.988	0.953	1.024
AGL36	PDall	agecat			newemploy2		outother	1.004	0.966	1.044
AGL37	PDall	agecat			newemploy2	niuse12		1.005	0.969	1.043
AGL38	PDall	agecat		newincome			outother	0.994	0.996	1.033
AGL39	PDall	agecat		newincome		niuse12		0.996	0.960	1.033
AGL40	PDall	agecat		newincome	newemploy2			0.993	0.957	1.029
AGL41	PDall	agecat	newrace			niuse12		0.997	0.963	1.033
AGL42	PDall	agecat	newrace		newemploy2			0.992	0.958	1.027
AGL43	PDall	agecat	newrace					0.994	0.958	1.032
AGL44	PDall		newrace	newincome				0.988	0.952	1.026
AGL45	PDall			newincome	newemploy2			0.992	0.956	1.028
AGL46	PDall				newemploy2	niuse12		1.001	0.965	1.037
AGL47	PDall					niuse12	outother	1.006	0.966	1.047
AGL48	PDall	agecat		newincome				0.992	0.956	1.031
AGL49	PDall	agecat			newemploy2			1.002	0.965	1.041

AGL50	PDall	agecat				niuse12		1.009	0.970	1.050
AGL51	PDall	agecat					outother	1.007	0.966	1.050
AGL52	PDall		newrace		newemploy2			0.992	0.956	1.028
AGL53	PDall		newrace			niuse12		0.997	0.960	1.034
AGL54	PDall		newrace				outother	0.995	0.957	1.035
AGL55	PDall			newincome		niuse12		0.995	0.958	1.032
AGL56	PDall			newincome			outother	0.993	0.955	1.032
AGL57	PDall				newemploy2		outother	1.000	0.962	1.039
AGL58	PDall	agecat						1.006	0.966	1.048
AGL59	PDall		newrace					0.994	0.957	1.033
AGL60	PDall			newincome				0.992	0.955	1.030
AGL61	PDall				newemploy2			0.998	0.962	1.037
AGL62	PDall					niuse12		1.005	0.967	1.548
AGL63	PDall						outother	1.003	0.963	1.045
AGL64	PDall							1.002	0.963	1.043

Table 3. GENMOD Model Odds Ratios for Partial Perceived Discrimination

model #	exposure	model covariates						OR	95% CI, lower	95% CI, upper
PGE1	PDpartial	agecat	newrace	newincome	newemploy2	niuse12	outother	0.980	0.933	1.029
PGE2	PDpartial	agecat	newrace	newincome	newemploy2	niuse12		0.971	0.925	1.019
PGE3	PDpartial	agecat	newrace	newincome	newemploy2		outother	0.974	0.923	1.027
PGE4	PDpartial	agecat	newrace	newincome		niuse12	outother	0.982	0.932	1.035
PGE5	PDpartial	agecat	newrace		newemploy2	niuse12	outother	0.987	0.938	1.040
PGE6	PDpartial	agecat		newincome	newemploy2	niuse12	outother	0.991	0.944	1.039
PGE7	PDpartial		newrace	newincome	newemploy2	niuse12	outother	0.997	0.953	1.042
PGE8	PDpartial			newincome	newemploy2	niuse12	outother	1.008	0.964	1.054
PGE9	PDpartial	agecat			newemploy2	niuse12	outother	1.004	0.952	1.059
PGE10	PDpartial	agecat	newrace			niuse12	outother	0.990	0.935	1.049
PGE11	PDpartial	agecat	newrace	newincome			outother	0.977	0.922	1.035
PGE12	PDpartial	agecat	newrace	newincome	newemploy2			0.964	0.915	1.016
PGE13	PDpartial		newrace		newemploy2	niuse12	outother	0.998	0.953	1.046
PGE14	PDpartial		newrace	newincome		niuse12	outother	1.011	0.964	1.060
PGE15	PDpartial		newrace	newincome	newemploy2		outother	0.991	0.947	1.038
PGE16	PDpartial		newrace	newincome	newemploy2	niuse12		0.991	0.949	1.034
PGE17	PDpartial	agecat		newincome		niuse12	outother	0.997	0.947	1.050
PGE18	PDpartial	agecat		newincome	newemploy2		outother	0.985	0.934	1.038
PGE19	PDpartial	agecat		newincome	newemploy2	niuse12		0.981	0.936	1.027
PGE20	PDpartial	agecat	newrace		newemploy2		outother	0.980	0.927	1.036
PGE21	PDpartial	agecat	newrace		newemploy2	niuse12		0.978	0.929	1.029
PGE22	PDpartial	agecat	newrace	newincome		niuse12		0.974	0.925	1.025

PGE23	PDpartial				newemploy2	niuse12	outother	1.013	0.966	1.064
PGE24	PDpartial	agecat				niuse12	outother	1.016	0.954	1.081
PGE25	PDpartial	agecat	newrace				outother	0.983	0.924	1.046
PGE26	PDpartial	agecat	newrace	newincome				0.968	0.915	1.025
PGE27	PDpartial			newincome		niuse12	outother	1.027	0.978	1.077
PGE28	PDpartial			newincome	newemploy2		outother	1.002	0.957	1.048
PGE29	PDpartial			newincome	newemploy2	niuse12		1.000	0.958	1.044
PGE30	PDpartial		newrace			niuse12	outother	1.011	0.961	1.064
PGE31	PDpartial		newrace		newemploy2		outother	0.990	0.944	1.039
PGE32	PDpartial		newrace		newemploy2	niuse12		0.992	0.948	1.037
PGE33	PDpartial		newrace	newincome			outother	1.007	0.959	1.058
PGE34	PDpartial		newrace	newincome		niuse12		1.005	0.960	1.052
PGE35	PDpartial		newrace	newincome	newemploy2			0.985	0.942	1.029
PGE36	PDpartial	agecat			newemploy2		outother	0.996	0.940	1.055
PGE37	PDpartial	agecat			newemploy2	niuse12		0.993	0.944	1.045
PGE38	PDpartial	agecat		newincome			outother	0.993	0.937	1.052
PGE39	PDpartial	agecat		newincome		niuse12		0.987	0.939	1.038
PGE40	PDpartial	agecat		newincome	newemploy2			0.974	0.925	1.025
PGE41	PDpartial	agecat	newrace			niuse12		0.982	0.927	1.039
PGE42	PDpartial	agecat	newrace		newemploy2			0.969	0.917	1.023
PGE43	PDpartial	agecat	newrace					0.974	0.916	1.035
PGE44	PDpartial		newrace	newincome				1.001	0.955	1.050
PGE45	PDpartial			newincome	newemploy2			0.994	0.951	1.039
PGE46	PDpartial				newemploy2	niuse12		1.001	0.957	1.048
PGE47	PDpartial					niuse12	outother	1.036	0.980	1.094
PGE48	PDpartial	agecat		newincome				0.982	0.929	1.039
PGE49	PDpartial	agecat			newemploy2			0.984	0.932	1.040

PGE50	PDpartial	agecat				niuse12		1.007	0.949	1.069
PGE51	PDpartial	agecat					outother	1.010	0.942	1.082
PGE52	PDpartial		newrace		newemploy2			1.027	0.938	1.030
PGE53	PDpartial		newrace			niuse12		1.006	0.957	1.056
PGE54	PDpartial		newrace				outother	1.004	0.953	1.058
PGE55	PDpartial			newincome		niuse12		1.019	0.973	1.067
PGE56	PDpartial			newincome			outother	1.023	0.973	1.075
PGE57	PDpartial				newemploy2		outother	1.005	0.956	1.056
PGE58	PDpartial	agecat						1.001	0.937	1.069
PGE59	PDpartial		newrace					0.999	0.949	1.051
PGE60	PDpartial			newincome				1.015	0.967	1.064
PGE61	PDpartial				newemploy2			0.997	0.951	1.045
PGE62	PDpartial					niuse12		1.029	0.976	1.084
PGE63	PDpartial						outother	1.029	0.971	1.090
PGE64	PDpartial							1.022	0.967	1.080

Table 4. GLIMMIX Model Odds Ratios for Partial Perceived Discrimination

model #	exposure	model covariates						OR	95% CI, lower	95% CI, upper
PGL1	PDpartial	agecat	newrace	newincome	newemploy2	niuse12	outother	0.993	0.946	1.042
PGL2	PDpartial	agecat	newrace	newincome	newemploy2	niuse12		0.991	0.945	1.039
PGL3	PDpartial	agecat	newrace	newincome	newemploy2		outother	0.988	0.941	1.038
PGL4	PDpartial	agecat	newrace	newincome		niuse12	outother	0.993	0.945	1.043
PGL5	PDpartial	agecat	newrace		newemploy2	niuse12	outother	1.004	0.955	1.055
PGL6	PDpartial	agecat		newincome	newemploy2	niuse12	outother	1.003	0.953	1.055
PGL7	PDpartial		newrace	newincome	newemploy2	niuse12	outother	0.995	0.945	1.047
PGL8	PDpartial			newincome	newemploy2	niuse12	outother	1.001	0.951	1.055
PGL9	PDpartial	agecat			newemploy2	niuse12	outother	1.020	0.967	1.076
PGL10	PDpartial	agecat	newrace			niuse12	outother	1.008	0.956	1.062
PGL11	PDpartial	agecat	newrace	newincome			outother	0.988	0.939	1.040
PGL12	PDpartial	agecat	newrace	newincome	newemploy2			0.986	0.940	1.036
PGL13	PDpartial		newrace		newemploy2	niuse12	outother	1.002	0.950	1.057
PGL14	PDpartial		newrace	newincome		niuse12	outother	0.996	0.944	1.050
PGL15	PDpartial		newrace	newincome	newemploy2		outother	0.991	0.941	1.044
PGL16	PDpartial		newrace	newincome	newemploy2	niuse12		0.993	0.944	1.045
PGL17	PDpartial	agecat		newincome		niuse12	outother	1.003	0.952	1.057
PGL18	PDpartial	agecat		newincome	newemploy2		outother	0.998	0.948	1.051
PGL19	PDpartial	agecat		newincome	newemploy2	niuse12		1.000	0.952	1.051
PGL20	PDpartial	agecat	newrace		newemploy2		outother	0.999	0.950	1.051
PGL21	PDpartial	agecat	newrace		newemploy2	niuse12		1.001	0.954	1.051
PGL22	PDpartial	agecat	newrace	newincome		niuse12		0.991	0.944	1.040

PGL23	PDpartial				newemploy2	niuse12	outother	1.013	0.960	1.069
PGL24	PDpartial	agecat				niuse12	outother	1.025	0.969	1.085
PGL25	PDpartial	agecat	newrace				outother	1.003	0.950	1.059
PGL26	PDpartial	agecat	newrace	newincome				0.986	0.938	1.037
PGL27	PDpartial			newincome		niuse12	outother	1.002	0.950	1.057
PGL28	PDpartial			newincome	newemploy2		outother	0.998	0.947	1.051
PGL29	PDpartial			newincome	newemploy2	niuse12		1.000	0.950	1.051
PGL30	PDpartial		newrace			niuse12	outother	1.007	0.952	1.065
PGL31	PDpartial		newrace		newemploy2		outother	0.999	0.946	1.054
PGL32	PDpartial		newrace		newemploy2	niuse12		1.001	0.950	1.054
PGL33	PDpartial		newrace	newincome			outother	0.992	0.940	1.047
PGL34	PDpartial		newrace	newincome		niuse12		0.995	0.944	1.048
PGL35	PDpartial		newrace	newincome	newemploy2			0.990	0.941	1.042
PGL36	PDpartial	agecat			newemploy2		outother	1.015	0.961	1.071
PGL37	PDpartial	agecat			newemploy2	niuse12		1.017	0.966	1.071
PGL38	PDpartial	agecat		newincome			outother	0.998	0.946	1.053
PGL39	PDpartial	agecat		newincome		niuse12		1.001	0.951	1.054
PGL40	PDpartial	agecat		newincome	newemploy2			0.996	0.947	1.047
PGL41	PDpartial	agecat	newrace			niuse12		1.005	0.955	1.058
PGL42	PDpartial	agecat	newrace		newemploy2			0.997	0.948	1.048
PGL43	PDpartial	agecat	newrace					1.001	0.949	1.056
PGL44	PDpartial		newrace	newincome				0.991	0.940	1.045
PGL45	PDpartial			newincome	newemploy2			0.996	0.946	1.048
PGL46	PDpartial				newemploy2	niuse12		1.011	0.959	1.065
PGL47	PDpartial					niuse12	outother	1.019	0.963	1.079
PGL48	PDpartial	agecat		newincome				0.996	0.945	1.050
PGL49	PDpartial	agecat			newemploy2			1.012	0.960	1.067

PGL50	PDpartial	agecat				niuse12		1.023	0.968	1.081
PGL51	PDpartial	agecat					outother	1.020	0.962	1.081
PGL52	PDpartial		newrace		newemploy2			0.997	0.946	1.052
PGL53	PDpartial		newrace			niuse12		1.006	0.952	1.062
PGL54	PDpartial		newrace				outother	1.003	0.947	1.062
PGL55	PDpartial			newincome		niuse12		1.001	0.950	1.055
PGL56	PDpartial			newincome			outother	0.998	0.945	1.054
PGL57	PDpartial				newemploy2		outother	1.009	0.956	1.897
PGL58	PDpartial	agecat						1.018	0.962	1.078
PGL59	PDpartial		newrace					1.002	0.947	1.059
PGL60	PDpartial			newincome				0.997	0.945	1.051
PGL61	PDpartial				newemploy2			1.008	0.955	1.063
PGL62	PDpartial					niuse12		1.018	0.963	1.076
PGL63	PDpartial						outother	1.015	0.958	1.076
PGL64	PDpartial							1.014	0.958	1.073

APPENDIX E

The Association of Structural Discrimination and HIV Prevalence among Men who Have Sex with Men in the United States

Confounding and Precision Assessment

TABLES OF ODDS RATIOS

A series of GENMOD and GLIMMIX models including all possible combinations of covariates (i.e., all variables other than the exposure of interest) were run. GLIMMIX models were run with only a random intercept. Tables 1-16 present odds ratios (ORs) for a one-unit change in overall structural discrimination, same-sex partnership recognition, and prohibitions of same-sex marriage.

The tables are grouped first by the relevant measure of structural discrimination, then by value of the relevant interaction term, and finally by model type (i.e., GENMOD or GLIMMIX). Each table shows ORs calculated for the structural discrimination measure of interest based on the relevant GENMOD or GLIMMIX model. The first row of each table shows the “full” model (i.e., all variables included). The last row of each table presents the “reduced” model (i.e., only the exposure of interest included). The intervening rows depict models based on all possible combinations of covariates.

The first column of each table shows the model number. The second column of each table presents the exposure of interest. The next six columns show the covariates included in each particular model. Next are the OR for the exposure and its corresponding 95% confidence interval (CI).

For the overall and same-sex partnership recognition discrimination indices, employment status remained in a significant interaction term with the exposure of interest after interaction was assessed. Employment status was specified, as follows:

- Unemployed, retired, disabled for work, or other (=1).
- Employed full-time or part-time, homemaker, or full-time student (=0).

For the same-sex marriage prohibition, race/ethnicity remained in a significant interaction term with the exposure of interest after interaction was evaluated. Race/ethnicity was categorized into the following groups:

- Black, not Hispanic (=3).
- Hispanic (=2).
- Other [American Indian, Alaska Native, Native Hawaiian/Pacific Islander, Other, Multiracial (=1).
- White, not Hispanic (=0).

Table 1. GENMOD Model Odds Ratios for Overall Structural Discrimination (where employment status=1)

model #	exposure	model covariates					OR	95% CI, lower	95% CI, upper
OGEX1	overallSDI2008	agecat	newrace	newincome	niuse12	outother	0.950	0.891	1.014
OGEX2	overallSDI2008		newrace	newincome	niuse12	outother	0.956	0.897	1.020
OGEX3	overallSDI2008	agecat		newincome	niuse12	outother	0.953	0.894	1.016
OGEX4	overallSDI2008	agecat	newrace		niuse12	outother	0.963	0.902	1.029
OGEX5	overallSDI2008	agecat	newrace	newincome		outother	0.952	0.892	1.017
OGEX6	overallSDI2008	agecat	newrace	newincome	niuse12		0.943	0.886	1.004
OGEX7	overallSDI2008			newincome	niuse12	outother	0.955	0.894	1.019
OGEX8	overallSDI2008	agecat			niuse12	outother	0.962	0.907	1.034
OGEX9	overallSDI2008	agecat	newrace			outother	0.965	0.902	1.032
OGEX10	overallSDI2008	agecat	newrace	newincome			0.944	0.886	1.006
OGEX11	overallSDI2008		newrace		niuse12	outother	0.970	0.910	1.034
OGEX12	overallSDI2008		newrace	newincome		outother	0.958	0.897	1.022
OGEX13	overallSDI2008		newrace	newincome	niuse12		0.950	0.890	1.014
OGEX14	overallSDI2008	agecat		newincome		outother	0.954	0.894	1.018
OGEX15	overallSDI2008	agecat		newincome	niuse12		0.944	0.887	1.005
OGEX16	overallSDI2008	agecat	newrace		niuse12		0.952	0.894	1.015
OGEX17	overallSDI2008				niuse12	outother	0.969	0.909	1.034
OGEX18	overallSDI2008	agecat				outother	0.970	0.907	1.036
OGEX19	overallSDI2008	agecat	newrace				0.953	0.893	1.017
OGEX20	overallSDI2008			newincome		outother	0.955	0.894	1.021
OGEX21	overallSDI2008			newincome	niuse12		0.947	0.886	1.012
OGEX22	overallSDI2008		newrace			outother	0.971	0.909	1.036

OGEX23	overallSDI2008		newrace	newincome			0.951	0.890	1.015
OGEX24	overallSDI2008	agecat			niuse12		0.955	0.897	1.017
OGEX25	overallSDI2008	agecat		newincome			0.944	0.886	1.006
OGEX26	overallSDI2008	agecat					0.955	0.896	1.018
OGEX27	overallSDI2008		newrace				0.961	0.901	1.025
OGEX28	overallSDI2008			newincome			0.947	0.885	1.013
OGEX29	overallSDI2008				niuse12		0.958	0.898	1.022
OGEX30	overallSDI2008					outother	0.969	0.908	1.035
OGEX31	overallSDI2008						0.958	0.897	1.023

Table 2. GENMOD Model Odds Ratios for Overall Structural Discrimination (where employment status=0)

model #	exposure	model covariates					OR	95% CI, lower	95% CI, upper
OGEY1	overallSDI2008	agecat	newrace	newincome	niuse12	outother	0.985	0.916	1.060
OGEY2	overallSDI2008		newrace	newincome	niuse12	outother	1.011	0.947	1.079
OGEY3	overallSDI2008	agecat		newincome	niuse12	outother	0.999	0.929	1.075
OGEY4	overallSDI2008	agecat	newrace		niuse12	outother	0.999	0.924	1.080
OGEY5	overallSDI2008	agecat	newrace	newincome		outother	0.976	0.906	1.050
OGEY6	overallSDI2008	agecat	newrace	newincome	niuse12		0.981	0.913	1.055
OGEY7	overallSDI2008			newincome	niuse12	outother	1.025	0.959	1.095
OGEY8	overallSDI2008	agecat			niuse12	outother	1.026	0.947	1.110
OGEY9	overallSDI2008	agecat	newrace			outother	0.989	0.915	1.070
OGEY10	overallSDI2008	agecat	newrace	newincome			0.972	0.903	1.046
OGEY11	overallSDI2008		newrace		niuse12	outother	1.018	0.951	1.089
OGEY12	overallSDI2008		newrace	newincome		outother	0.998	0.938	1.066
OGEY13	overallSDI2008		newrace	newincome	niuse12		1.007	0.945	1.073
OGEY14	overallSDI2008	agecat		newincome		outother	0.991	0.920	1.067
OGEY15	overallSDI2008	agecat		newincome	niuse12		0.995	0.926	1.070
OGEY16	overallSDI2008	agecat	newrace		niuse12		0.995	0.922	1.075
OGEY17	overallSDI2008				niuse12	outother	1.041	0.970	1.117
OGEY18	overallSDI2008	agecat				outother	1.017	0.939	1.102
OGEY19	overallSDI2008	agecat	newrace				0.986	0.913	1.065
OGEY20	overallSDI2008			newincome		outother	1.014	0.949	1.084
OGEY21	overallSDI2008			newincome	niuse12		1.021	0.956	1.090
OGEY22	overallSDI2008		newrace			outother	1.005	0.940	1.075

OGEY23	overallSDI2008		newrace	newincome			0.996	0.935	1.061
OGEY24	overallSDI2008	agecat			niuse12		1.023	0.946	1.106
OGEY25	overallSDI2008	agecat		newincome			0.987	0.917	1.063
OGEY26	overallSDI2008	agecat					1.015	0.938	1.098
OGEY27	overallSDI2008		newrace				1.002	0.938	1.070
OGEY28	overallSDI2008			newincome			1.011	0.946	1.079
OGEY29	overallSDI2008				niuse12		1.038	0.969	1.112
OGEY30	overallSDI2008					outother	1.029	0.960	1.104
OGEY31	overallSDI2008						1.027	0.958	1.100

Table 3. GLIMMIX Model Odds Ratios for Overall Structural Discrimination (where employment status=1)

model #	exposure	model covariates					OR	95% CI, lower	95% CI, upper
OGLX1	overallSDI2008	agecat	newrace	newincome	niuse12	outother	0.949	0.888	1.014
OGLX2	overallSDI2008		newrace	newincome	niuse12	outother	0.954	0.891	1.020
OGLX3	overallSDI2008	agecat		newincome	niuse12	outother	0.951	0.890	1.015
OGLX4	overallSDI2008	agecat	newrace		niuse12	outother	0.962	0.899	1.030
OGLX5	overallSDI2008	agecat	newrace	newincome		outother	0.949	0.887	1.015
OGLX6	overallSDI2008	agecat	newrace	newincome	niuse12		0.944	0.884	1.007
OGLX7	overallSDI2008			newincome	niuse12	outother	0.952	0.889	1.020
OGLX8	overallSDI2008	agecat			niuse12	outother	0.967	0.903	1.034
OGLX9	overallSDI2008	agecat	newrace			outother	0.962	0.898	1.031
OGLX10	overallSDI2008	agecat	newrace	newincome			0.943	0.883	1.008
OGLX11	overallSDI2008		newrace		niuse12	outother	0.968	0.904	1.036
OGLX12	overallSDI2008		newrace	newincome		outother	0.953	0.890	1.021
OGLX13	overallSDI2008		newrace	newincome	niuse12		0.948	0.885	1.015
OGLX14	overallSDI2008	agecat		newincome		outother	0.950	0.889	1.016
OGLX15	overallSDI2008	agecat		newincome	niuse12		0.944	0.885	1.007
OGLX16	overallSDI2008	agecat	newrace		niuse12		0.954	0.894	1.019
OGLX17	overallSDI2008				niuse12	outother	0.967	0.903	1.036
OGLX18	overallSDI2008	agecat				outother	0.966	0.901	1.034
OGLX19	overallSDI2008	agecat	newrace				0.954	0.892	1.020
OGLX20	overallSDI2008			newincome		outother	0.951	0.887	1.020
OGLX21	overallSDI2008			newincome	niuse12		0.946	0.881	1.015
OGLX22	overallSDI2008		newrace			outother	0.967	0.902	1.037

OGLX23	overallSDI2008		newrace	newincome			0.947	0.883	1.015
OGLX24	overallSDI2008	agecat			niuse12		0.957	0.896	1.021
OGLX25	overallSDI2008	agecat		newincome			0.943	0.883	1.007
OGLX26	overallSDI2008	agecat					0.955	0.894	1.021
OGLX27	overallSDI2008		newrace				0.959	0.895	1.028
OGLX28	overallSDI2008			newincome			0.944	0.879	1.014
OGLX29	overallSDI2008				niuse12		0.958	0.894	1.026
OGLX30	overallSDI2008					outother	0.966	0.901	1.036
OGLX31	overallSDI2008						0.956	0.891	1.026

Table 4. GLIMMIX Model Odds Ratios for Overall Structural Discrimination (where employment status=0)

model #	exposure	model covariates					OR	95% CI, lower	95% CI, upper
OGLY1	overallSDI2008	agecat	newrace	newincome	niuse12	outother	0.996	0.926	1.071
OGLY2	overallSDI2008		newrace	newincome	niuse12	outother	1.008	0.936	1.086
OGLY3	overallSDI2008	agecat		newincome	niuse12	outother	1.003	0.929	1.083
OGLY4	overallSDI2008	agecat	newrace		niuse12	outother	1.010	0.938	1.088
OGLY5	overallSDI2008	agecat	newrace	newincome		outother	0.989	0.918	1.066
OGLY6	overallSDI2008	agecat	newrace	newincome	niuse12		0.994	0.925	1.068
OGLY7	overallSDI2008			newincome	niuse12	outother	1.011	0.937	1.091
OGLY8	overallSDI2008	agecat			niuse12	outother	1.023	0.944	1.108
OGLY9	overallSDI2008	agecat	newrace			outother	1.004	0.930	1.083
OGLY10	overallSDI2008	agecat	newrace	newincome			0.988	0.917	1.063
OGLY11	overallSDI2008		newrace		niuse12	outother	1.018	0.944	1.098
OGLY12	overallSDI2008		newrace	newincome		outother	1.002	0.929	1.081
OGLY13	overallSDI2008		newrace	newincome	niuse12		1.006	0.935	1.082
OGLY14	overallSDI2008	agecat		newincome		outother	0.997	0.922	1.077
OGLY15	overallSDI2008	agecat		newincome	niuse12		1.001	0.928	1.080
OGLY16	overallSDI2008	agecat	newrace		niuse12		1.008	0.937	1.085
OGLY17	overallSDI2008				niuse12	outother	1.025	0.948	1.109
OGLY18	overallSDI2008	agecat				outother	1.016	0.936	1.102
OGLY19	overallSDI2008	agecat	newrace				1.001	0.928	1.080
OGLY20	overallSDI2008			newincome		outother	1.005	0.931	1.086
OGLY21	overallSDI2008			newincome	niuse12		1.009	0.936	1.088
OGLY22	overallSDI2008		newrace			outother	1.012	0.936	1.093

OGLY23	overallSDI2008		newrace	newincome			1.000	0.928	1.077
OGLY24	overallSDI2008	agecat			niuse12		1.021	0.943	1.105
OGLY25	overallSDI2008	agecat		newincome			0.995	0.921	1.075
OGLY26	overallSDI2008	agecat					1.014	0.935	1.100
OGLY27	overallSDI2008		newrace				1.010	0.935	1.090
OGLY28	overallSDI2008			newincome			1.004	0.930	1.083
OGLY29	overallSDI2008				niuse12		1.023	0.947	1.106
OGLY30	overallSDI2008					outother	1.019	0.941	1.104
OGLY31	overallSDI2008						1.017	0.940	1.101

Table 5. GENMOD Model Odds Ratios for Same-Sex Partnership Structural Discrimination (where employment status=1)

model #	exposure	model covariates					OR	95% CI, lower	95% CI, upper
PGEX1	partnership2008	agecat	newrace	newincome	niuse12	outother	0.963	0.838	1.107
PGEX2	partnership2008		newrace	newincome	niuse12	outother	0.954	0.817	1.114
PGEX3	partnership2008	agecat		newincome	niuse12	outother	0.969	0.837	1.122
PGEX4	partnership2008	agecat	newrace		niuse12	outother	0.978	0.859	1.114
PGEX5	partnership2008	agecat	newrace	newincome		outother	0.965	0.837	1.111
PGEX6	partnership2008	agecat	newrace	newincome	niuse12		0.938	0.816	1.079
PGEX7	partnership2008			newincome	niuse12	outother	0.948	0.806	1.113
PGEX8	partnership2008	agecat			niuse12	outother	0.993	0.866	1.138
PGEX9	partnership2008	agecat	newrace			outother	0.980	0.858	1.119
PGEX10	partnership2008	agecat	newrace	newincome			0.938	0.814	1.081
PGEX11	partnership2008		newrace		niuse12	outother	0.974	0.842	1.126
PGEX12	partnership2008		newrace	newincome		outother	0.956	0.816	1.119
PGEX13	partnership2008		newrace	newincome	niuse12		0.934	0.799	1.092
PGEX14	partnership2008	agecat		newincome		outother	0.969	0.836	1.123
PGEX15	partnership2008	agecat		newincome	niuse12		0.940	0.812	1.086
PGEX16	partnership2008	agecat	newrace		niuse12		0.951	0.836	1.082
PGEX17	partnership2008				niuse12	outother	0.971	0.838	1.126
PGEX18	partnership2008	agecat				outother	0.991	0.863	1.138
PGEX19	partnership2008	agecat	newrace				0.951	0.834	1.085
PGEX20	partnership2008			newincome		outother	0.947	0.804	1.116
PGEX21	partnership2008			newincome	niuse12		0.924	0.785	1.088
PGEX22	partnership2008		newrace			outother	0.975	0.841	1.131

PGEX23	partnership2008		newrace	newincome			0.934	0.798	1.094
PGEX24	partnership2008	agecat			niuse12		0.958	0.839	1.094
PGEX25	partnership2008	agecat		newincome			0.938	0.809	1.086
PGEX26	partnership2008	agecat					0.955	0.835	1.092
PGEX27	partnership2008		newrace				0.951	0.822	1.101
PGEX28	partnership2008			newincome			0.923	0.782	1.088
PGEX29	partnership2008				niuse12		0.943	0.814	1.094
PGEX30	partnership2008					outother	0.970	0.835	1.128
PGEX31	partnership2008						0.941	0.810	1.094

Table 6. GENMOD Model Odds Ratios for Same-Sex Partnership Structural Discrimination (where employment status=0)

model #	exposure	model covariates					OR	95% CI, lower	95% CI, upper
PGEY1	partnership2008	agecat	newrace	newincome	niuse12	outother	1.020	0.894	1.165
PGEY2	partnership2008		newrace	newincome	niuse12	outother	1.077	0.954	1.216
PGEY3	partnership2008	agecat		newincome	niuse12	outother	1.031	0.889	1.197
PGEY4	partnership2008	agecat	newrace		niuse12	outother	1.059	0.921	1.218
PGEY5	partnership2008	agecat	newrace	newincome		outother	0.997	0.868	1.146
PGEY6	partnership2008	agecat	newrace	newincome	niuse12		1.012	0.887	1.156
PGEY7	partnership2008			newincome	niuse12	outother	1.093	0.958	1.247
PGEY8	partnership2008	agecat			niuse12	outother	1.089	0.922	1.286
PGEY9	partnership2008	agecat	newrace			outother	1.039	0.899	1.201
PGEY10	partnership2008	agecat	newrace	newincome			0.990	0.861	1.138
PGEY11	partnership2008		newrace		niuse12	outother	1.101	0.971	1.248
PGEY12	partnership2008		newrace	newincome		outother	1.059	0.939	1.194
PGEY13	partnership2008		newrace	newincome	niuse12		1.065	0.944	1.200
PGEY14	partnership2008	agecat		newincome		outother	1.010	0.865	1.181
PGEY15	partnership2008	agecat		newincome	niuse12		1.023	0.882	1.187
PGEY16	partnership2008	agecat	newrace		niuse12		1.049	0.914	1.204
PGEY17	partnership2008				niuse12	outother	1.130	0.978	1.306
PGEY18	partnership2008	agecat				outother	1.071	0.901	1.274
PGEY19	partnership2008	agecat	newrace				1.029	0.892	1.188
PGEY20	partnership2008			newincome		outother	1.075	0.943	1.225
PGEY21	partnership2008			newincome	niuse12		1.083	0.950	1.233
PGEY22	partnership2008		newrace			outother	1.083	0.956	1.227

PGEY23	partnership2008		newrace	newincome			1.047	0.929	1.180
PGEY24	partnership2008	agecat			niuse12		1.080	0.916	1.273
PGEY25	partnership2008	agecat		newincome			1.003	0.858	1.172
PGEY26	partnership2008	agecat					1.063	0.896	1.262
PGEY27	partnership2008		newrace				1.071	0.947	1.211
PGEY28	partnership2008			newincome			1.065	0.935	1.213
PGEY29	partnership2008				niuse12		1.121	0.973	1.293
PGEY30	partnership2008					outother	1.114	0.963	1.287
PGEY31	partnership2008						1.105	0.958	1.275

Table 7. GLIMMIX Model Odds Ratios for Same-Sex Partnership Structural Discrimination (where employment status=1)

model #	exposure	model covariates					OR	95% CI, lower	95% CI, upper	% diff.
PGLX1	partnership2008	agecat	newrace	newincome	niuse12	outother	0.957	0.836	1.095	0.000
PGLX2	partnership2008		newrace	newincome	niuse12	outother	0.950	0.811	1.113	0.007
PGLX3	partnership2008	agecat		newincome	niuse12	outother	0.964	0.835	1.111	0.007
PGLX4	partnership2008	agecat	newrace		niuse12	outother	0.970	0.853	1.103	0.014
PGLX5	partnership2008	agecat	newrace	newincome		outother	0.957	0.834	1.098	0.000
PGLX6	partnership2008	agecat	newrace	newincome	niuse12		0.936	0.817	1.071	0.022
PGLX7	partnership2008			newincome	niuse12	outother	0.943	0.801	1.111	0.014
PGLX8	partnership2008	agecat			niuse12	outother	0.984	0.860	1.127	0.029
PGLX9	partnership2008	agecat	newrace			outother	0.970	0.851	1.106	0.014
PGLX10	partnership2008	agecat	newrace	newincome			0.936	0.816	1.074	0.022
PGLX11	partnership2008		newrace		niuse12	outother	0.968	0.834	1.123	0.012
PGLX12	partnership2008		newrace	newincome		outother	0.950	0.809	1.115	0.007
PGLX13	partnership2008		newrace	newincome	niuse12		0.930	0.793	1.090	0.028
PGLX14	partnership2008	agecat		newincome		outother	0.961	0.832	1.110	0.005
PGLX15	partnership2008	agecat		newincome	niuse12		0.938	0.814	1.080	0.020
PGLX16	partnership2008	agecat	newrace		niuse12		0.946	0.834	1.074	0.011
PGLX17	partnership2008				niuse12	outother	0.965	0.830	1.122	0.009
PGLX18	partnership2008	agecat				outother	0.982	0.856	1.125	0.026
PGLX19	partnership2008	agecat	newrace				0.946	0.832	1.076	0.011
PGLX20	partnership2008			newincome		outother	0.941	0.797	1.110	0.017
PGLX21	partnership2008			newincome	niuse12		0.919	0.779	1.085	0.039
PGLX22	partnership2008		newrace			outother	0.967	0.832	1.125	0.011

PGLX23	partnership2008		newrace	newincome			0.930	0.792	1.092	0.028
PGLX24	partnership2008	agecat			niuse12		0.954	0.837	1.087	0.003
PGLX25	partnership2008	agecat		newincome			0.935	0.810	1.080	0.022
PGLX26	partnership2008	agecat					0.951	0.833	1.086	0.006
PGLX27	partnership2008		newrace				0.945	0.813	1.097	0.012
PGLX28	partnership2008			newincome			0.917	0.776	1.084	0.041
PGLX29	partnership2008				niuse12		0.937	0.805	1.089	0.021
PGLX30	partnership2008					outother	0.962	0.826	1.122	0.006
PGLX31	partnership2008						0.934	0.801	1.089	0.023

Table 8. GLIMMIX Model Odds Ratios for Same-Sex Partnership Structural Discrimination (where employment status=0)

model #	exposure	model covariates					OR	95% CI, lower	95% CI, upper
PGLY1	partnership2008	agecat	newrace	newincome	niuse12	outother	1.052	0.921	1.202
PGLY2	partnership2008		newrace	newincome	niuse12	outother	1.062	0.932	1.219
PGLY3	partnership2008	agecat		newincome	niuse12	outother	1.077	0.932	1.245
PGLY4	partnership2008	agecat	newrace		niuse12	outother	1.073	0.930	1.237
PGLY5	partnership2008	agecat	newrace	newincome		outother	1.034	0.903	1.184
PGLY6	partnership2008	agecat	newrace	newincome	niuse12		1.044	0.915	1.192
PGLY7	partnership2008			newincome	niuse12	outother	1.078	0.934	1.244
PGLY8	partnership2008	agecat			niuse12	outother	1.109	0.943	1.303
PGLY9	partnership2008	agecat	newrace			outother	1.055	0.912	1.219
PGLY10	partnership2008	agecat	newrace	newincome			1.027	1.114	1.175
PGLY11	partnership2008		newrace		niuse12	outother	1.077	0.931	1.246
PGLY12	partnership2008		newrace	newincome		outother	1.048	0.912	1.204
PGLY13	partnership2008		newrace	newincome	niuse12		1.054	0.920	1.208
PGLY14	partnership2008	agecat		newincome		outother	1.059	0.916	1.225
PGLY15	partnership2008	agecat		newincome	niuse12		1.069	0.925	1.237
PGLY16	partnership2008	agecat	newrace		niuse12		1.065	0.924	1.227
PGLY17	partnership2008				niuse12	outother	1.101	0.943	1.286
PGLY18	partnership2008	agecat				outother	1.090	0.928	1.282
PGLY19	partnership2008	agecat	newrace				1.047	0.907	1.210
PGLY20	partnership2008			newincome		outother	1.063	0.922	1.227
PGLY21	partnership2008			newincome	niuse12		1.070	0.929	1.234
PGLY22	partnership2008		newrace			outother	1.062	0.917	1.231

PGLY23	partnership2008		newrace	newincome			1.040	0.907	1.193
PGLY24	partnership2008	agecat			niuse12		1.102	0.937	1.296
PGLY25	partnership2008	agecat		newincome			1.052	0.910	1.217
PGLY26	partnership2008	agecat					1.084	0.922	1.274
PGLY27	partnership2008		newrace				1.055	0.912	1.220
PGLY28	partnership2008			newincome			1.056	0.917	1.217
PGLY29	partnership2008				niuse12		1.094	0.938	1.277
PGLY30	partnership2008					outother	1.086	0.930	1.269
PGLY31	partnership2008						1.080	0.925	1.261

Table 9. GENMOD Model Odds Ratios for Same-Sex Marriage Prohibition (where race/ethnicity=3)

model #	exposure	model covariates					OR	95% CI, lower	95% CI, upper
MGEW1	marriage2008	agecat	newincome	newemploy2	niuse12	outother	0.959	0.715	1.286
MGEW2	marriage2008		newincome	newemploy2	niuse12	outother	1.027	0.808	1.305
MGEW3	marriage2008	agecat		newemploy2	niuse12	outother	0.966	0.710	1.316
MGEW4	marriage2008	agecat	newincome		niuse12	outother	0.972	0.717	1.318
MGEW5	marriage2008	agecat	newincome	newemploy2		outother	0.967	0.717	1.304
MGEW6	marriage2008	agecat	newincome	newemploy2	niuse12		0.944	0.711	1.254
MGEW7	marriage2008			newemploy2	niuse12	outother	1.037	0.792	1.359
MGEW8	marriage2008	agecat			niuse12	outother	0.978	0.707	1.353
MGEW9	marriage2008	agecat	newincome			outother	0.985	0.723	1.342
MGEW10	marriage2008	agecat	newincome	newemploy2			0.949	0.711	1.268
MGEW11	marriage2008		newincome		niuse12	outother	1.052	0.825	1.341
MGEW12	marriage2008		newincome	newemploy2		outother	1.026	0.805	1.306
MGEW13	marriage2008		newincome	newemploy2	niuse12		1.023	0.809	1.295
MGEW14	marriage2008	agecat		newemploy2		outother	0.973	0.709	1.334
MGEW15	marriage2008	agecat		newemploy2	niuse12		0.955	0.708	1.287
MGEW16	marriage2008	agecat	newincome		niuse12		0.956	0.713	1.282
MGEW17	marriage2008				niuse12	outother	1.057	0.797	1.400
MGEW18	marriage2008	agecat				outother	0.988	0.710	1.374
MGEW19	marriage2008	agecat	newincome				0.965	0.715	1.301
MGEW20	marriage2008			newemploy2		outother	1.032	0.784	1.357
MGEW21	marriage2008			newemploy2	niuse12		1.041	0.799	1.357
MGEW22	marriage2008		newincome			outother	1.054	0.828	1.343

MGEW23	marriage2008		newincome	newemploy2			1.021	0.806	1.294
MGEW24	marriage2008	agecat			niuse12		0.966	0.706	1.322
MGEW25	marriage2008	agecat		newemploy2			0.959	0.707	1.301
MGEW26	marriage2008	agecat					0.973	0.707	1.340
MGEW27	marriage2008		newincome				1.050	0.830	1.329
MGEW28	marriage2008			newemploy2			1.035	0.792	1.354
MGEW29	marriage2008				niuse12		1.063	0.808	1.398
MGEW30	marriage2008					outother	1.052	0.793	1.395
MGEW31	marriage2008						1.059	0.804	1.393

Table 10. GENMOD Model Odds Ratios for Same-Sex Marriage Prohibition (where race/ethnicity=2)

model #	exposure	model covariates					OR	95% CI, lower	95% CI, upper
MGEX1	marriage2008	agecat	newincome	newemploy2	niuse12	outother	0.875	0.764	1.003
MGEX2	marriage2008		newincome	newemploy2	niuse12	outother	0.944	0.802	1.112
MGEX3	marriage2008	agecat		newemploy2	niuse12	outother	0.916	0.778	1.077
MGEX4	marriage2008	agecat	newincome		niuse12	outother	0.876	0.763	1.005
MGEX5	marriage2008	agecat	newincome	newemploy2		outother	0.866	0.750	1.000
MGEX6	marriage2008	agecat	newincome	newemploy2	niuse12		0.885	0.769	1.019
MGEX7	marriage2008			newemploy2	niuse12	outother	0.977	0.812	1.175
MGEX8	marriage2008	agecat			niuse12	outother	0.921	0.776	1.093
MGEX9	marriage2008	agecat	newincome			outother	0.867	0.747	1.006
MGEX10	marriage2008	agecat	newincome	newemploy2			0.876	0.755	1.016
MGEX11	marriage2008		newincome		niuse12	outother	0.948	0.803	1.119
MGEX12	marriage2008		newincome	newemploy2		outother	0.931	0.790	1.096
MGEX13	marriage2008		newincome	newemploy2	niuse12		0.939	0.797	1.106
MGEX14	marriage2008	agecat		newemploy2		outother	0.910	0.770	1.074
MGEX15	marriage2008	agecat		newemploy2	niuse12		0.918	0.777	1.085
MGEX16	marriage2008	agecat	newincome		niuse12		0.885	0.769	1.018
MGEX17	marriage2008				niuse12	outother	0.986	0.815	1.193
MGEX18	marriage2008	agecat				outother	0.918	0.768	1.097
MGEX19	marriage2008	agecat	newincome				0.876	0.753	1.018
MGEX20	marriage2008			newemploy2		outother	0.966	0.804	1.159
MGEX21	marriage2008			newemploy2	niuse12		0.969	0.808	1.163
MGEX22	marriage2008		newincome			outother	0.936	0.791	1.107

MGEX23	marriage2008		newincome	newemploy2			0.926	0.786	1.093
MGEX24	marriage2008	agecat			niuse12		0.921	0.776	1.095
MGEX25	marriage2008	agecat		newemploy2			0.912	0.768	1.083
MGEX26	marriage2008	agecat					0.918	0.767	1.100
MGEX27	marriage2008		newincome				0.930	0.786	1.101
MGEX28	marriage2008			newemploy2			0.958	0.798	1.150
MGEX29	marriage2008				niuse12		0.977	0.810	1.178
MGEX30	marriage2008					outother	0.977	0.807	1.184
MGEX31	marriage2008						0.968	0.801	1.171

Table 11. GENMOD Model Odds Ratios for Same-Sex Marriage Prohibition (where race/ethnicity=1)

model #	exposure	model covariates					OR	95% CI, lower	95% CI, upper
MGEY1	marriage2008	agecat	newincome	newemploy2	niuse12	outother	1.257	0.927	1.705
MGEY2	marriage2008		newincome	newemploy2	niuse12	outother	1.315	0.936	1.847
MGEY3	marriage2008	agecat		newemploy2	niuse12	outother	1.254	0.931	1.690
MGEY4	marriage2008	agecat	newincome		niuse12	outother	1.267	0.926	1.735
MGEY5	marriage2008	agecat	newincome	newemploy2		outother	1.281	0.960	1.709
MGEY6	marriage2008	agecat	newincome	newemploy2	niuse12		1.246	0.909	1.707
MGEY7	marriage2008			newemploy2	niuse12	outother	1.303	0.933	1.818
MGEY8	marriage2008	agecat			niuse12	outother	1.242	0.885	1.743
MGEY9	marriage2008	agecat	newincome			outother	1.302	0.967	1.753
MGEY10	marriage2008	agecat	newincome	newemploy2			1.284	0.962	1.713
MGEY11	marriage2008		newincome		niuse12	outother	1.329	0.936	1.886
MGEY12	marriage2008		newincome	newemploy2		outother	1.311	0.952	1.805
MGEY13	marriage2008		newincome	newemploy2	niuse12		1.317	0.934	1.857
MGEY14	marriage2008	agecat		newemploy2		outother	1.272	0.951	1.702
MGEY15	marriage2008	agecat		newemploy2	niuse12		1.239	0.917	1.676
MGEY16	marriage2008	agecat	newincome		niuse12		1.264	0.915	1.744
MGEY17	marriage2008				niuse12	outother	1.286	0.886	1.865
MGEY18	marriage2008	agecat				outother	1.271	0.910	1.776
MGEY19	marriage2008	agecat	newincome				1.313	0.977	1.766
MGEY20	marriage2008			newemploy2		outother	1.298	0.941	1.791
MGEY21	marriage2008			newemploy2	niuse12		1.299	0.929	1.816
MGEY22	marriage2008		newincome			outother	1.329	0.955	1.850

MGEY23	marriage2008		newincome	newemploy2			1.323	0.962	1.819
MGEY24	marriage2008	agecat			niuse12		1.237	0.879	1.742
MGEY25	marriage2008	agecat		newemploy2			1.268	0.950	1.693
MGEY26	marriage2008	agecat					1.277	0.915	1.781
MGEY27	marriage2008		newincome				1.348	0.971	1.872
MGEY28	marriage2008			newemploy2			1.302	0.946	1.792
MGEY29	marriage2008				niuse12		1.288	0.887	1.870
MGEY30	marriage2008					outother	1.287	0.896	1.848
MGEY31	marriage2008						1.297	0.905	1.858

Table 12. GENMOD Model Odds Ratios for Same-Sex Marriage Prohibition (where race/ethnicity=0)

model #	exposure	model covariates					OR	95% CI, lower	95% CI, upper
MGEZ1	marriage2008	agecat	newincome	newemploy2	niuse12	outother	1.182	1.025	1.362
MGEZ2	marriage2008		newincome	newemploy2	niuse12	outother	1.229	1.057	1.428
MGEZ3	marriage2008	agecat		newemploy2	niuse12	outother	1.233	1.063	1.429
MGEZ4	marriage2008	agecat	newincome		niuse12	outother	1.190	1.021	1.387
MGEZ5	marriage2008	agecat	newincome	newemploy2		outother	1.181	1.004	1.390
MGEZ6	marriage2008	agecat	newincome	newemploy2	niuse12		1.184	1.025	1.367
MGEZ7	marriage2008			newemploy2	niuse12	outother	1.259	1.073	1.477
MGEZ8	marriage2008	agecat			niuse12	outother	1.263	1.071	1.488
MGEZ9	marriage2008	agecat	newincome			outother	1.198	1.000	1.436
MGEZ10	marriage2008	agecat	newincome	newemploy2			1.183	1.003	1.395
MGEZ11	marriage2008		newincome		niuse12	outother	1.278	1.091	1.497
MGEZ12	marriage2008		newincome	newemploy2		outother	1.223	1.040	1.438
MGEZ13	marriage2008		newincome	newemploy2	niuse12		1.233	1.058	1.436
MGEZ14	marriage2008	agecat		newemploy2		outother	1.229	1.040	1.453
MGEZ15	marriage2008	agecat		newemploy2	niuse12		1.233	1.063	1.430
MGEZ16	marriage2008	agecat	newincome		niuse12		1.190	1.019	1.390
MGEZ17	marriage2008				niuse12	outother	1.317	1.108	1.566
MGEZ18	marriage2008	agecat				outother	1.265	1.047	1.529
MGEZ19	marriage2008	agecat	newincome				1.198	0.998	1.438
MGEZ20	marriage2008			newemploy2		outother	1.250	1.052	1.484
MGEZ21	marriage2008			newemploy2	niuse12		1.261	1.074	1.480
MGEZ22	marriage2008		newincome			outother	1.284	1.078	1.529

MGEZ23	marriage2008		newincome	newemploy2			1.227	1.041	1.446
MGEZ24	marriage2008	agecat			niuse12		1.262	1.070	1.488
MGEZ25	marriage2008	agecat		newemploy2			1.229	1.039	1.454
MGEZ26	marriage2008	agecat					1.265	1.046	1.530
MGEZ27	marriage2008		newincome				1.286	1.078	1.534
MGEZ28	marriage2008			newemploy2			1.252	1.053	1.488
MGEZ29	marriage2008				niuse12		1.318	1.108	1.567
MGEZ30	marriage2008					outother	1.315	1.085	1.593
MGEZ31	marriage2008						1.316	1.087	1.594

Table 13. GLIMMIX Model Odds Ratios for Same-Sex Marriage Prohibition (where race/ethnicity=3)

model #	exposure	model covariates					OR	95% CI, lower	95% CI, upper
MGLW1	marriage2008	agecat	newincome	newemploy2	niuse12	outother	0.996	0.758	1.309
MGLW2	marriage2008		newincome	newemploy2	niuse12	outother	1.024	0.785	1.336
MGLW3	marriage2008	agecat		newemploy2	niuse12	outother	1.030	0.772	1.372
MGLW4	marriage2008	agecat	newincome		niuse12	outother	0.998	0.753	1.323
MGLW5	marriage2008	agecat	newincome	newemploy2		outother	0.988	0.753	1.296
MGLW6	marriage2008	agecat	newincome	newemploy2	niuse12		0.997	0.763	1.302
MGLW7	marriage2008			newemploy2	niuse12	outother	1.057	0.797	1.402
MGLW8	marriage2008	agecat			niuse12	outother	1.040	0.772	1.400
MGLW9	marriage2008	agecat	newincome			outother	0.990	0.748	1.310
MGLW10	marriage2008	agecat	newincome	newemploy2			0.992	0.760	1.294
MGLW11	marriage2008		newincome		niuse12	outother	1.028	0.780	1.354
MGLW12	marriage2008		newincome	newemploy2		outother	1.017	0.779	1.326
MGLW13	marriage2008		newincome	newemploy2	niuse12		1.023	0.789	1.327
MGLW14	marriage2008	agecat		newemploy2		outother	1.022	0.769	1.359
MGLW15	marriage2008	agecat		newemploy2	niuse12		1.028	0.775	1.363
MGLW16	marriage2008	agecat	newincome		niuse12		0.995	0.759	1.316
MGLW17	marriage2008				niuse12	outother	1.066	0.796	1.427
MGLW18	marriage2008	agecat				outother	1.032	0.767	1.388
MGLW19	marriage2008	agecat	newincome				0.994	0.755	1.309
MGLW20	marriage2008			newemploy2		outother	1.050	0.792	1.392
MGLW21	marriage2008			newemploy2	niuse12		1.055	0.800	1.393
MGLW22	marriage2008		newincome			outother	1.020	0.774	1.344

MGLW23	marriage2008		newincome	newemploy2			1.018	0.784	1.321
MGLW24	marriage2008	agecat			niuse12		1.037	0.774	1.390
MGLW25	marriage2008	agecat		newemploy2			1.023	0.773	1.355
MGLW26	marriage2008	agecat					1.033	0.772	1.383
MGLW27	marriage2008		newincome				1.022	0.779	1.339
MGLW28	marriage2008			newemploy2			1.051	0.796	1.387
MGLW29	marriage2008				niuse12		1.065	0.799	1.419
MGLW30	marriage2008					outother	1.059	0.791	1.417
MGLW31	marriage2008						1.060	0.795	1.413

Table 14. GLIMMIX Model Odds Ratios for Same-Sex Marriage Prohibition (where race/ethnicity=2)

model #	exposure	model covariates					OR	95% CI, lower	95% CI, upper
MGLX1	marriage2008	agecat	newincome	newemploy2	niuse12	outother	0.871	0.754	1.006
MGLX2	marriage2008		newincome	newemploy2	niuse12	outother	0.941	0.798	1.110
MGLX3	marriage2008	agecat		newemploy2	niuse12	outother	0.907	0.767	1.073
MGLX4	marriage2008	agecat	newincome		niuse12	outother	0.871	0.753	1.008
MGLX5	marriage2008	agecat	newincome	newemploy2		outother	0.861	0.739	1.004
MGLX6	marriage2008	agecat	newincome	newemploy2	niuse12		0.885	0.767	1.021
MGLX7	marriage2008			newemploy2	niuse12	outother	0.974	0.815	1.164
MGLX8	marriage2008	agecat			niuse12	outother	0.910	0.764	1.083
MGLX9	marriage2008	agecat	newincome			outother	0.861	0.736	1.008
MGLX10	marriage2008	agecat	newincome	newemploy2			0.874	0.751	1.018
MGLX11	marriage2008		newincome		niuse12	outother	0.942	0.796	1.115
MGLX12	marriage2008		newincome	newemploy2		outother	0.928	0.785	1.098
MGLX13	marriage2008		newincome	newemploy2	niuse12		0.948	0.806	1.115
MGLX14	marriage2008	agecat		newemploy2		outother	0.898	0.755	1.068
MGLX15	marriage2008	agecat		newemploy2	niuse12		0.918	0.779	1.082
MGLX16	marriage2008	agecat	newincome		niuse12		0.988	0.767	1.020
MGLX17	marriage2008				niuse12	outother	0.976	0.811	1.175
MGLX18	marriage2008	agecat				outother	0.900	0.749	1.081
MGLX19	marriage2008	agecat	newincome				0.874	0.749	1.020
MGLX20	marriage2008			newemploy2		outother	0.961	0.801	1.152
MGLX21	marriage2008			newemploy2	niuse12		0.980	0.824	1.167
MGLX22	marriage2008		newincome			outother	0.929	0.781	1.105

MGLX23	marriage2008		newincome	newemploy2			0.935	0.792	1.104
MGLX24	marriage2008	agecat			niuse12		0.919	0.776	1.088
MGLX25	marriage2008	agecat		newemploy2			0.908	0.765	1.078
MGLX26	marriage2008	agecat					0.909	0.760	1.088
MGLX27	marriage2008		newincome				0.935	0.789	1.109
MGLX28	marriage2008			newemploy2			0.967	0.809	1.156
MGLX29	marriage2008				niuse12		0.982	0.820	1.175
MGLX30	marriage2008					outother	0.962	0.795	1.165
MGLX31	marriage2008						0.968	0.803	1.167

Table 15. GLIMMIX Model Odds Ratios for Same-Sex Marriage Prohibition (where race/ethnicity=1)

model #	exposure	model covariates					OR	95% CI, lower	95% CI, upper
MGLY1	marriage2008	agecat	newincome	newemploy2	niuse12	outother	1.230	0.856	1.767
MGLY2	marriage2008		newincome	newemploy2	niuse12	outother	1.278	0.882	1.853
MGLY3	marriage2008	agecat		newemploy2	niuse12	outother	1.268	0.903	1.780
MGLY4	marriage2008	agecat	newincome		niuse12	outother	1.238	0.855	1.792
MGLY5	marriage2008	agecat	newincome	newemploy2		outother	1.242	0.874	1.765
MGLY6	marriage2008	agecat	newincome	newemploy2	niuse12		1.232	0.869	1.746
MGLY7	marriage2008			newemploy2	niuse12	outother	1.304	0.913	1.862
MGLY8	marriage2008	agecat			niuse12	outother	1.285	0.899	1.835
MGLY9	marriage2008	agecat	newincome			outother	1.252	0.874	1.792
MGLY10	marriage2008	agecat	newincome	newemploy2			1.249	0.893	1.748
MGLY11	marriage2008		newincome		niuse12	outother	1.286	0.882	1.877
MGLY12	marriage2008		newincome	newemploy2		outother	1.279	0.893	1.831
MGLY13	marriage2008		newincome	newemploy2	niuse12		1.284	0.894	1.845
MGLY14	marriage2008	agecat		newemploy2		outother	1.281	0.915	1.794
MGLY15	marriage2008	agecat		newemploy2	niuse12		1.268	0.914	1.759
MGLY16	marriage2008	agecat	newincome		niuse12		1.241	0.867	1.776
MGLY17	marriage2008				niuse12	outother	1.319	0.910	1.910
MGLY18	marriage2008	agecat				outother	1.301	0.913	1.854
MGLY19	marriage2008	agecat	newincome				1.261	0.893	1.781
MGLY20	marriage2008			newemploy2		outother	1.308	0.922	1.857
MGLY21	marriage2008			newemploy2	niuse12		1.307	0.924	1.851
MGLY22	marriage2008		newincome			outother	1.288	0.894	1.857

MGLY23	marriage2008		newincome	newemploy2			1.288	0.909	1.826
MGLY24	marriage2008	agecat			niuse12		1.288	0.909	1.824
MGLY25	marriage2008	agecat		newemploy2			1.286	0.930	1.778
MGLY26	marriage2008	agecat					1.310	0.927	1.849
MGLY27	marriage2008		newincome				1.300	0.909	1.857
MGLY28	marriage2008			newemploy2			1.315	0.936	1.849
MGLY29	marriage2008				niuse12		1.324	0.919	1.907
MGLY30	marriage2008					outother	1.325	0.920	1.908
MGLY31	marriage2008						1.335	0.934	1.909

Table 16. GLIMMIX Model Odds Ratios for Same-Sex Marriage Prohibition (where race/ethnicity=0)

model #	exposure	model covariates					OR	95% CI, lower	95% CI, upper
MGLZ1	marriage2008	agecat	newincome	newemploy2	niuse12	outother	1.180	1.021	1.364
MGLZ2	marriage2008		newincome	newemploy2	niuse12	outother	1.222	1.043	1.432
MGLZ3	marriage2008	agecat		newemploy2	niuse12	outother	1.237	1.066	1.436
MGLZ4	marriage2008	agecat	newincome		niuse12	outother	1.184	1.012	1.386
MGLZ5	marriage2008	agecat	newincome	newemploy2		outother	1.180	1.000	1.393
MGLZ6	marriage2008	agecat	newincome	newemploy2	niuse12		1.182	1.022	1.368
MGLZ7	marriage2008			newemploy2	niuse12	outother	1.265	1.073	1.492
MGLZ8	marriage2008	agecat			niuse12	outother	1.271	1.076	1.500
MGLZ9	marriage2008	agecat	newincome			outother	1.186	0.988	1.423
MGLZ10	marriage2008	agecat	newincome	newemploy2			1.182	1.001	1.396
MGLZ11	marriage2008		newincome		niuse12	outother	1.232	1.038	1.462
MGLZ12	marriage2008		newincome	newemploy2		outother	1.218	1.027	1.446
MGLZ13	marriage2008		newincome	newemploy2	niuse12		1.224	1.045	1.435
MGLZ14	marriage2008	agecat		newemploy2		outother	1.239	1.045	1.468
MGLZ15	marriage2008	agecat		newemploy2	niuse12		1.238	1.067	1.437
MGLZ16	marriage2008	agecat	newincome		niuse12		1.185	1.012	1.387
MGLZ17	marriage2008				niuse12	outother	1.301	1.086	1.557
MGLZ18	marriage2008	agecat				outother	1.274	1.053	1.542
MGLZ19	marriage2008	agecat	newincome				1.186	0.989	1.424
MGLZ20	marriage2008			newemploy2		outother	1.263	1.056	1.509
MGLZ21	marriage2008			newemploy2	niuse12		1.267	1.075	1.493
MGLZ22	marriage2008		newincome			outother	1.228	1.019	1.481

MGLZ23	marriage2008		newincome	newemploy2			1.221	1.029	1.449
MGLZ24	marriage2008	agecat			niuse12		1.271	1.077	1.499
MGLZ25	marriage2008	agecat		newemploy2			1.240	1.046	1.469
MGLZ26	marriage2008	agecat					1.274	1.054	1.541
MGLZ27	marriage2008		newincome				1.230	1.020	1.482
MGLZ28	marriage2008			newemploy2			1.264	1.058	1.510
MGLZ29	marriage2008				niuse12		1.301	1.087	1.557
MGLZ30	marriage2008					outother	1.298	1.065	1.582
MGLZ31	marriage2008						1.299	1.067	1.581