

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/45183441>

Associations of Sex Ratios and Male Incarceration Rates with Multiple Opposite-Sex Partners: Potential Social Determinants of HIV/STI Transmission

ARTICLE *in* PUBLIC HEALTH REPORTS · JULY 2010

Impact Factor: 1.55 · DOI: 10.2307/41434922 · Source: PubMed

CITATIONS

35

READS

17

5 AUTHORS, INCLUDING:



[Enrique Rodriguez Pouget](#)

National Development and Research Instit...

85 PUBLICATIONS 1,308 CITATIONS

SEE PROFILE



[Linda M Niccolai](#)

Yale University

104 PUBLICATIONS 1,775 CITATIONS

SEE PROFILE



[Kim M Blankenship](#)

American University Washington D.C.

53 PUBLICATIONS 1,547 CITATIONS

SEE PROFILE

Associations of Sex Ratios and Male Incarceration Rates with Multiple Opposite-Sex Partners: Potential Social Determinants of HIV/STI Transmission

ENRIQUE R. POUGET, PhD^a
TRACE S. KERSHAW, PhD^b
LINDA M. NICCOLAI, PhD^b
JEANNETTE R. ICKOVICS, PhD^b
KIM M. BLANKENSHIP, PhD^c

SYNOPSIS

Objectives. Racial/ethnic disparities in heterosexual transmission of human immunodeficiency virus (HIV) and other sexually transmitted infections (STIs) have been hypothesized to be related to the high rate of incarceration and the shortage of men in black communities. This study tested associations of having multiple sex partners with these factors.

Methods. Racial/ethnic-specific Census data on the sex ratio and the male incarceration rate were categorized into tertiles and matched with individual data from the National Health and Nutrition Examination Survey 1999–2004 by county of residence for non-Hispanic black, non-Hispanic white, and Mexican American participants. We used logistic regression analyses to examine whether these factors were associated with having multiple opposite-sex partners in the past year.

Results. Sex ratios and incarceration rates varied greatly by race/ethnicity; however, we observed significant associations within each racial/ethnic group. Non-Hispanic black men in counties with a greater shortage of males (adjusted odds ratio [AOR] = 1.9; 95% confidence interval [CI] 1.1, 3.5) and a greater number of incarcerated males (AOR=1.6; 95% CI 1.1, 2.3) in the non-Hispanic black population had significantly greater odds of having two or more partners. Those in two low sex-ratio categories (AOR=2.4; 95% CI 1.0, 5.8 and AOR=4.1; 95% CI 1.6, 10.0) and one high incarceration-rate category (AOR=2.1; 95% CI 1.2, 3.6) had significantly greater odds of having five or more partners.

Conclusion. Sex ratios and incarceration rates were associated with the number of opposite-sex partners in some groups. Because the risk of HIV/STI transmission depends, in part, on the number of partners, it is important to determine the causal relationships among these associations to help better understand racial/ethnic HIV/STI disparities and improve prevention programs and interventions.

^aNational Development and Research Institutes, Inc., New York, NY

^bDepartment of Epidemiology and Public Health, Yale University School of Medicine, New Haven, CT

^cDepartment of Sociology, Duke University, Durham, NC

Address correspondence to: Enrique R. Pouget, PhD, National Development and Research Institutes, Inc., 71 W. 23rd St., 8th Floor, New York, NY 10010; tel. 212-845-4488; fax 917-438-0894; e-mail <pouget@ndri.org>.

©2010 Association of Schools of Public Health

It is widely recognized that black people are disproportionately impacted by the human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS) epidemic in the U.S. Non-Hispanic black (NHB) individuals represented 47% of new diagnoses of HIV or AIDS in 2006.¹ Similar disparities exist for chlamydia, gonorrhea, syphilis, and genital herpes.^{2,3} Among NHB individuals, heterosexual contact is reported to be the leading route of HIV acquisition for women and the second leading route of acquisition for men.¹ The number of sexual partners is a principal determinant of the likelihood of acquiring HIV infection and other sexually transmitted infections (STIs).⁴ National data show that NHB individuals report more recent opposite-sex partners, on average, than do non-Hispanic white (NHW) or Hispanic people.^{5,6} The rate of acquisition of opposite-sex partners can be influenced by the availability of those partners.

The relative availability of male and female partners in a population is reflected in the male-to-female sex ratio, measured by convention as the number of men per 100 women.⁷ For studies of sexual behavior, the sex ratio in the reproductive age range of 15–49 years is of particular interest. Women tend to slightly outnumber men in this age range, due to their lower mortality; however, substantial variation in sex ratios has been observed cross-culturally and across time.^{7,8}

The national NHB population has a low sex ratio in the reproductive age range, reflecting a shortage of men, while the NHW and Hispanic sex ratios in this age range reflect a surplus of men: 91.8, 101.9, and 112.8 men per 100 women, respectively.⁹ Further, these values underestimate the shortage of men among NHB populations because they include inmates of correctional facilities. Several factors are believed to be responsible for the shortage of men in the NHB population, including low sex ratio at birth, internal migration and regional differences, excess male mortality, and incarceration.^{7,10}

Sex-ratio theory

Social exchange theory describes a mechanism by which sex ratios can affect sexual partnerships.^{7,11,12} According to this theory, satisfaction with sexual and social relationships depends upon prior expectations, comparison with alternatives, investments made in the relationship, and the perception of reciprocity.¹³ Through this perspective, male shortage can be viewed as increasing the bargaining power of men and reducing the bargaining power of women in intimate relationships by reducing the available alternative relationships for women and increasing the available alternative relationships for men. Competition among women

reduces the cost for men to have sexual partnerships with women, while the cost for women to have sexual partnerships with men is usually minimal.¹⁴ These potential differences in motivations and costs may be enhanced by social and cultural systems that limit alternative means for women to obtain resources.

With respect to heterosexual dyads, social exchange theory can be contextualized by consideration of the theory of gender and power.¹⁵ This theory describes the power imbalance between men and women that occurs at different levels of social organization, including families, institutions, workplaces, communities, cultures, and societies. Major social structures that characterize the gendered relationships between men and women are the sexual division of labor, the sexual division of physical and psychological power, and the structure of intimate relationships, including social behavioral and relationship norms. A shortage of men can serve to further diminish women's dyadic power. The limited dyadic power of women in sexual relationships has been recognized as a central issue in prevention.^{16–18}

Dyadic power is also shaped by social structures that constrain sexual partnership formation. For example, in male-dominated societies, high sex ratios can lead to increased female sex work.⁷ In addition, psychological factors and social factors such as cultural norms regarding marriage can modify the relationship between sex ratios and partner acquisition. In this way, sex-ratio theory is compatible with social determinants models of STI transmission that posit ecological or social factors interacting with epidemiologic factors and behaviors to influence risk.¹⁹ Low sex ratios may be a “cause of one of the causes” of HIV/STI transmission. Sex ratios vary as a result of factors outside of individual control. If living in an area with a low sex ratio leads to having more sexual partners, then the area sex ratio can be considered a social determinant of health, as the number of sexual partners is a principal determinant of HIV/STI acquisition, particularly for people who live in high-prevalence areas.⁴

Empirical studies

Low sex ratios have been found to be a barrier for marriage and have been investigated with regard to effects on family formation, crime, and female sex work.^{14,20–23} More recently, public health researchers, motivated by interest in understanding racial HIV/STI disparities, have studied sex ratios.

Qualitative data suggest that some black women perceive that male shortage facilitates female partner acquisition for men.^{24–30} Several qualitative studies have examined the sex ratio among black people as a

potential determinant of concurrent sexual relationships and HIV/STI risk.^{25,26,28} These studies suggest that male shortage, as well as high rates of incarceration, unemployment, and poverty, with roots in racial discrimination, support partnership concurrency and lead to more dense sexual networks and higher rates of HIV/STI transmission.^{25,26,28}

Quantitative studies of sex ratios, sexual behavior, and STI rates in the U.S. have had mixed results. One ecological study found that a bivariate association between sex ratios and syphilis rates was accounted for by other factors in adjusted analyses.³¹ A recent clinical study found that sex ratios calculated at the census-tract level were not associated with the number of partners among men and were positively associated among women.³² The average sex ratio among tracts was only 78.6. Further analysis indicated that this association was due to an increase in exchanging sex for money or drugs among women in tracts with higher sex ratios. However, it is unclear how well census tracts represent the geographic area people use when considering the availability of potential partners.³³ The association between sex ratios and sexual risk behavior has also been studied quantitatively in international settings, with results generally supporting a negative association.^{34–36}

Some quantitative studies have focused not on the sex ratio itself, but on incarceration.^{37–42} Several ecological studies of incarceration rates and STI and AIDS prevalence rates have been published or are available as working papers, with results generally supporting a positive association.^{43–45} Having a partner who was incarcerated has also been found to be positively associated with having multiple, concurrent, and transactional sex partners, and having had a recent HIV/STI diagnosis.^{41,42,46,47}

Another important factor for HIV/STI transmission is the mixing between individuals at the core and periphery of sexual networks.⁴⁸ A sexual network refers to the chain of individuals representing one's sexual partners and the partners of one's partners. Individuals at the periphery of a sexual network have one partner, while individuals who have more partners form a network core.⁴⁹ Individuals at the core are important for HIV/STI transmission, if they are infected, because they contact more partners than those at the periphery. Mixing between individuals with similar characteristics is referred to as "assortative," while mixing between individuals with dissimilar characteristics is referred to as "disassortative." Sexual partnerships tend to be assortative on important demographic characteristics, including race/ethnicity, age, religion, and education.⁵⁰ Survey data show that heterosexual partnerships among

NHB and NHW women are more than 80% assortative by race/ethnicity, while those among Hispanic and Asian women are 63% and 59% assortative, respectively.⁵¹ Due to racially assortative mixing, the likelihood among African Americans that individuals in the periphery of a network will have partners in the core of a network is five times that of white people.⁴⁹ This network mixing makes infections among individuals in the periphery more likely, particularly if core individuals are male, because transmission from males to females is more efficient.⁴

Using population data stratified by race/ethnicity, it is possible to test the associations of sex ratios in assortative and disassortative racial/ethnic groups with sexual partner acquisition. This study analyzed population measures matched with survey data to test, at the national level, the associations of male shortage and high incarceration rates with the number of opposite-sex partners.

METHODS

Data sources

Individual cross-sectional data from the National Health and Nutrition Examination Survey (NHANES) 1999–2004 were combined for analysis. NHANES data were collected in two-year sampling waves, using a stratified, multistage, clustered design to produce a representative sample of the U.S. population. To facilitate racial/ethnic comparisons, we oversampled some demographic groups, including NHB and Mexican American populations. We collected the data through in-home survey and mobile examination centers for biological assessments and surveys of data considered sensitive, such as sexual behavior. Sexual behavior questionnaires were administered via audio computer-assisted self-interview procedures.

We obtained population data from the 2000 U.S. Census⁹ and matched individual data from NHANES with county-level data (by participant county of residence) from the Census through a special arrangement with the National Center for Health Statistics.

Sample population

A total of 31,126 participants were examined in NHANES 1999–2004. Participants were questioned regarding their sexual behavior if they were aged 14–59 years, provided separate consent for the sexual-behavior questionnaire, were not mentally impaired, and could understand survey instructions in either English or Spanish. Questions regarding the number of sexual partners in the past year were limited to participants who were aged 18–59 years and reported ever having

had sex. For this study, we included the 8,041 participants who fit the criteria for questions regarding the number of sexual partners in the past year, and who were NHB, NHW, or Mexican American. A total of 669 participants were excluded because they were of other or mixed race/ethnicity, including non-Mexican American Hispanic individuals.

Study measures

The main outcome variable was having had more than one sexual partner in the past year. We also examined the variable of having had five or more partners in the past year. We selected the dichotomous coding of having had five or more partners in the past year because a high rate of partner acquisition is one definition of being at the core of a sexual network, and individuals at the core play an important role in HIV/STI transmission within and between populations.^{4,49,52-54} Other NHANES data included in the analyses were data collection wave, age, education level, family income, marital status, and place of birth (U.S.- or foreign-born).

We obtained several population measures from the Census. We calculated sex ratios by selecting the population in the reproductive age range (15–49 years) in the county of residence, dividing the number of males by the number of females, and multiplying the result by 100. Correctional facility populations were subtracted before calculating sex ratios.

We calculated two sex ratios for each racial/ethnic group—matched (assortative) and disassortative. Matched sex ratios were calculated using population data regarding county residents of the same race/ethnicity as the participant. Disassortative sex ratios were calculated using population data regarding county residents who were of a racial/ethnic group other than that of the participant. To avoid unreliable calculations based on small numbers, we excluded sex ratios if the number of county residents of the racial/ethnic category of interest was less than 1,000.

The rate of men aged 18–64 years in correctional facilities per 10,000 population was used as a measure of male incarceration. This age range was used as a proxy for the 15–49 years age range, for which data were not available by sex and race/ethnicity. To facilitate comparisons, we categorized sex ratios and correctional facility rates by tertiles of the weighted, race/ethnicity-stratified distributions. Tertile categorization allows for the examination of nonlinearity of effects, while maximizing statistical power. Other Census data included in the analyses were region (Northeast, South, Midwest, or West), poverty rate, and county size code—an ordinal variable reflecting the population size.

Based on analyses of national data on population benchmarks, such as births, deaths, and immigration, the Census 2000 was known to have undercounted NHB men.⁵⁵ Therefore, we used estimates of undercounting to adjust county population data for sensitivity analyses, as described in the next section.⁵⁶

Statistical analysis

We analyzed the data with SUDAAN[®] version 9.0⁵⁷ using guidelines provided by NHANES.^{58,59} SUDAAN produces parameter estimates and standard errors that are adjusted for complex sampling and shared variance within geographic units, using a Taylor series linearization expansion method.⁶⁰ Sample means and standard error values were adjusted for the unequal probability of selection, nonresponse, and post-stratification. Separate analyses for men and women were planned, because we hypothesized sex ratios to have differential effects on sexual behavior.

We assessed associations using weighted logistic regressions. Although the outcome measures were common, and the odds ratios should not be interpreted as relative risks, we used logistic regressions because procedures for weighting and adjustment for sampling were not available with other methods that could assess nonlinear effects.

We evaluated the significance of the overall tests comparing trichotomous sex-ratio and correctional facility rate variables using Satterthwaite adjusted F-statistics. To test the significance of the difference between each tertile category and the reference group, we used a t-test for each corresponding beta coefficient to evaluate the null hypothesis that $\beta=0$. Control variables were evaluated for inclusion in adjusted models with partial likelihood ratio tests.⁶¹

Based on preliminary analyses, we included the following variables in all adjusted models: matched and disassortative sex ratio and correctional facility rate indicators, data collection wave, age group, family income, marital status, place of birth, region, poverty rate, and county population size. There was little evidence of multicollinearity, except between education and family income. Family income was retained, as it was typically more strongly associated with the outcome. To test the sensitivity of the analyses to potential differential Census undercounting, we repeated the analyses for NHB individuals using data adjusted for undercounting. We also repeated the main analyses with a model-based approach using SAS[®] PROC GLIMMIX (version 9.1.3)⁶² to test the sensitivity of effects to the choice of statistical procedures.

RESULTS

A total of 1,951 NHB, 4,095 NHW, and 1,995 Mexican American participants had valid data and were included in the analysis. Participant characteristics are presented in Table 1. Geographic and contextual data are presented in Table 2. There were stark racial/ethnic differences in matched sex ratios. Linear regression of the matched sex ratios showed strong racial/ethnic group differences ($F=198.5$; degree of freedom [df]=2, 30; $p<0.0001$), with NHB respondents having lower sex ratios than their NHW and Mexican American counterparts, and Mexican Americans having higher sex ratios than NHW and NHB respondents. Correctional facility rates also varied greatly by race/ethnicity ($F=40.6$; df=2, 30; $p<0.0001$), with NHB respondents

having higher correctional facility rates than NHW and Mexican American respondents, and Mexican Americans having higher correctional facility rates than NHW respondents. Pearson correlations between the logged values of matched sex ratios and correctional facility rates were modest among NHW and NHB respondents, and somewhat greater among Mexican Americans: 0.12, -0.24, and 0.41, respectively.

Logistic regression results, stratified by race/ethnicity and sex, are presented in Tables 3 and 4. To facilitate comparisons, the tables present odds ratios (ORs) and adjusted odds ratios (AORs) for tertiles of matched and disassortative sex ratios and male correctional facility rates. The reference groups for sex-ratio categories represent the groups with the highest sex

Table 1. Weighted NHANES 1999–2004 participant characteristic percentages, stratified by race/ethnicity and sex

Characteristic	Non-Hispanic black		Non-Hispanic white		Mexican American	
	Men (n=945)	Women (n=1,006)	Men (n=1,903)	Women (n=2,192)	Men (n=939)	Women (n=1,056)
	Weighted percent	Weighted percent	Weighted percent	Weighted percent	Weighted percent	Weighted percent
Data collection wave						
1999–2000	27.6	30.1	30.2	29.9	28.2	31.8
2001–2002	37.6	33.8	36.1	36.3	34.7	29.8
2003–2004	34.8	36.2	33.7	33.8	37.1	38.4
Age group (in years)						
18–29	31.8	30.4	25.1	24.7	44.8	42.3
30–39	26.7	28.4	26.3	25.2	27.2	26.8
40–59	41.5	41.2	48.6	50.1	28.0	30.9
Marital status						
Never married	37.9	35.7	20.8	14.6	25.7	18.9
Widowed, divorced, separated	12.6	25.3	10.4	15.5	6.1	12.6
Married/cohabiting	49.5	39.0	68.8	70.0	68.2	68.6
Education						
<High school	31.1	27.2	10.5	10.9	49.4	46.3
High school graduate/GED	26.8	24.8	28.2	25.1	24.5	21.7
>High school	42.1	48.0	61.3	64.1	26.1	32.0
Family income						
<Poverty level	21.6	28.0	8.0	11.3	23.6	28.9
1–4 times poverty level	53.7	53.3	44.5	44.1	61.9	58.5
>4 times poverty level	24.7	18.7	47.5	44.6	14.5	12.6
Place of birth						
Outside the U.S.	10.0	6.7	4.5	3.7	60.2	52.2
U.S.	90.0	93.4	95.5	96.3	39.8	47.8
More than one partner in past year						
Yes	40.5	21.3	15.0	10.3	22.2	11.5
No	59.6	78.7	85.0	89.7	77.9	88.5
Five or more partners in past year						
Yes	13.5	4.1	3.0	1.7	5.7	1.8
No	86.5	95.9	97.1	98.3	94.3	98.3

NHANES = National Health and Nutrition Examination Survey

GED = general equivalency diploma

Table 2. Weighted geographic and contextual characteristics of the counties of residence for NHANES 1999–2004 participants, stratified by race/ethnicity

Characteristic	Non-Hispanic black respondents	Non-Hispanic white respondents	Mexican American respondents
	Mean (SE)	Mean (SE)	Mean (SE)
Matched sex ratio ^a	84.8 (0.61)	99.5 (0.40)	113.1 (2.60)
Disassortative sex ratio ^b	101.8 (0.71)	100.8 (1.65)	100.3 (2.60)
Matched male correctional facility rate ^c	565.5 (59.40)	94.4 (14.80)	172.0 (26.86)
Region (percent [SE])			
Northeast	16.6 (4.08)	18.4 (2.78)	1.5 (0.80)
Midwest	21.7 (4.38)	25.3 (2.43)	9.5 (3.41)
South	55.5 (5.29)	36.4 (3.30)	34.7 (8.02)
West	6.2 (0.99)	19.9 (2.60)	54.3 (6.84)
County size code ^d	19.7 (0.17)	18.6 (0.22)	20.4 (0.23)
Poverty rate ^e	14.8 (0.64)	11.5 (0.53)	14.1 (1.00)

^aMatched sex ratio was calculated using the male and female population of the race/ethnicity of the participant in the county of residence.

^bDisassortative sex ratio was calculated using the male and female population among racial/ethnic groups other than that of the participant in the county of residence.

^cMatched male correctional facility rate refers to the number of men in correctional facilities per 10,000 population of the race/ethnicity of the participant in the county of residence.

^dCounty size code indicates population size (range for this study is 11: 2,000–2,499 to 23: >5 million).

^ePoverty rate refers to the family income of the participant, relative to the poverty level for a family of a given size, as defined by the U.S. Census Bureau.

NHANES = National Health and Nutrition Examination Survey

SE = standard error

ratio, while the reference groups for the male correctional facility rate categories represent the groups with the lowest rate. The range of values within each group is also displayed.

As shown in Table 3, in adjusted analysis among NHB men, those in the middle matched sex-ratio group had almost twice the odds of having had more than one partner in the past year as those in the highest matched sex-ratio group (AOR=1.9; 95% confidence interval [CI] 1.1, 3.5). In addition, NHB men in the middle correctional facility rate group had 60% greater adjusted odds of having had more than one partner in the past year than those in the lowest correctional facility rate group (AOR=1.6; 95% CI 1.1, 2.3). There were no significant sex-ratio or correctional facility rate group effects among NHB women.

We did not observe any significant sex-ratio or correctional facility rate effects on the odds of having had more than one partner in the past year among NHW men. In unadjusted analysis among NHW women, those in the middle correctional facility rate group were less likely to have had more than one partner in the past year, compared with those in the lowest correctional facility rate group; but these effects did not remain significant in adjusted analysis.

Mexican American men in the middle disassortative

sex-ratio group had more than twice the odds of having had more than one partner in the past year as those in the highest disassortative sex-ratio group in adjusted analysis (AOR=2.3; 95% CI 1.1, 5.0). Mexican American men in the highest correctional facility rate group had more than twice the adjusted odds of having had more than one partner in the past year as those in the lowest correctional facility rate group (AOR=2.1; 95% CI 1.2, 3.4). Mexican American women in the lowest disassortative sex-ratio group had more than three times the adjusted odds of having had more than one partner in the past year as those in the highest disassortative sex-ratio group (AOR=3.8; 95% CI 1.7, 8.5), and those in the highest correctional facility rate group had more than twice the adjusted odds of having had more than one partner in the past year as those in the lowest correctional facility rate group (AOR=2.1; 95% CI 1.1, 4.2).

Logistic regression results for having had five or more partners in the past year among men are presented in Table 4. An insufficient number of women reported having had five or more partners in the past year for analysis. NHB men in the lowest and middle matched sex-ratio groups had more than twice and more than four times the odds of having had five or more partners in the past year as the highest matched

sex-ratio group, in adjusted analysis (AOR=2.4; 95% CI 1.0, 5.8 and AOR=4.1; 95% CI 1.6, 10.0, respectively). NHB men in the middle correctional facility rate group had more than twice the odds of having had five or more partners in the past year as those in the lowest correctional facility rate group (AOR=2.1; 95% CI 1.2, 3.6). NHW men in the middle correctional facility rate group had more than three times the odds of having had five or more partners in the past year as those in the lowest correctional facility rate group, in adjusted analysis (AOR=3.3; 95% CI 1.9, 5.9). Among Mexican American men, having had five or more partners in the past year was not associated with sex-ratio or correctional facility rate groups. Results of analyses that used a cutoff value of four or six or more partners in the past year were similar (data not shown).

Results of models for NHB respondents based on data adjusted for estimates of Census undercounting were similar (data not shown). Results of model-based

analyses using SAS PROC GLIMMIX were also similar (data not shown); however, these models were more sensitive to multicollinearity and were run using a reduced number of control variables.

DISCUSSION

These results show that NHB men in counties with a shortage of NHB men and a high NHB male incarceration rate are more likely to have more than one opposite-sex partner than those in counties with more balanced sex ratios. Male shortage and incarceration rates are also associated with having five or more partners—an indication of central position within a sexual network. Because these results are cross-sectional, more research is needed to assess causality among these associations, but one possibility is that low sex ratios lead some men to have more partners by increasing female partner availability, and male incarceration further

Table 3. Logistic regression results for the odds of having had multiple partners in the past year by sex-ratio and correctional facility rate tertile groups among non-Hispanic black, non-Hispanic white, and Mexican American male and female participants, NHANES 1999–2004

Characteristic	Non-Hispanic black men		Non-Hispanic black women	
	OR (95% CI)	AOR ^a (95% CI)	OR (95% CI)	AOR ^a (95% CI)
Matched sex ratio ^b				
76.0 to 81.0	1.2 (0.7, 1.8)	1.2 (0.8, 1.9)	0.9 (0.6, 1.4)	0.9 (0.5, 1.5)
81.1 to 83.7	1.5 (0.9, 2.5)	1.9 (1.1, 3.5) ^c	1.0 (0.6, 1.5)	1.3 (0.6, 2.5)
83.8 to 137.3	1.0	1.0 ^d	1.0	1.0
Disassortative sex ratio ^e				
90.6 to 99.6	1.1 (0.7, 1.8)	0.7 (0.5, 1.2)	1.1 (0.7, 1.6)	1.3 (0.8, 2.0)
99.7 to 103.2	1.0 (0.6, 1.6)	1.1 (0.7, 1.7)	0.7 (0.4, 1.1)	0.7 (0.4, 1.1)
103.3 to 117.0	1.0	1.0	1.0	1.0 ^d
Correctional facility rate ^f				
42.3 to 299.9	1.0 ^d	1.0 ^d	1.0	1.0
300.0 to 496.5	1.6 (1.1, 2.4) ^c	1.6 (1.1, 2.3) ^c	0.9 (0.6, 1.3)	0.7 (0.4, 1.2)
496.6 to 2,753.0	1.0 (0.6, 1.6)	0.8 (0.5, 1.4)	0.9 (0.6, 1.3)	0.9 (0.5, 1.4)
Characteristic	Non-Hispanic white men		Non-Hispanic white women	
	OR (95% CI)	AOR ^a (95% CI)	OR (95% CI)	AOR ^a (95% CI)
Matched sex ratio ^b				
89.9 to 98.0	1.3 (0.8, 2.2)	1.4 (0.9, 2.2)	1.3 (0.9, 1.9)	1.2 (0.7, 2.2)
98.1 to 100.2	1.4 (0.9, 2.0)	1.5 (0.9, 2.5)	1.5 (1.0, 2.3)	1.2 (0.7, 2.1)
100.3 to 111.8	1.0	1.0	1.0	1.0
Disassortative sex ratio ^e				
79.1 to 95.8	1.0 (0.7, 1.5)	0.9 (0.6, 1.4)	1.5 (1.0, 2.2)	1.3 (0.7, 2.4)
95.9 to 106.1	1.1 (0.7, 1.6)	1.3 (0.8, 2.1)	0.8 (0.5, 1.1)	1.1 (0.7, 1.8)
106.2 to 126.2	1.0	1.0	1.0	1.0
Correctional facility rate ^f				
10.2 to 44.4	1.0	1.0	1.0 ^d	1.0
44.5 to 64.0	0.9 (0.6, 1.3)	1.0 (0.6, 1.7)	0.6 (0.4, 0.9) ^c	0.9 (0.6, 1.4)
64.1 to 1377.7	1.0 (0.6, 1.6)	0.8 (0.6, 1.3)	0.8 (0.6, 1.1)	0.8 (0.6, 1.1)

continued on p. 77

increases that availability by dissolving existing partnerships of men who are incarcerated. Sex ratios and incarceration rates are associated with other factors that may be causally related to these findings, such as differential mortality, employment-related internal migration, and military service. High incarceration rates may also be acting on behavior indirectly, by undermining neighborhood social cohesion and control.⁶³

Notably, these associations were stronger for NHB men grouped in the middle categories. The effects were smaller and mostly nonsignificant for men in the lowest sex-ratio category and highest correctional facility rate category. We conjecture that the non-monotonicity of these associations could reflect systematic sampling bias, due to counties with the greatest male shortage and highest incarceration rates containing more unstably housed men, who may have more sex partners and may be less likely to be sampled.

The lack of comparability of sex-ratio and incarceration rate exposures among racial/ethnic groups limits

the interpretation of results. Sex ratios and incarceration rates in the counties of residence were so different by race/ethnicity that separate analyses were required. Both the middle and low matched sex-ratio tertiles for NHB respondents represent low ranges compared with those of NHW and Mexican American respondents. Similarly, middle and high correctional facility rate tertiles for NHB respondents represent high ranges compared with those of NHW and Mexican American respondents. Male shortage appears to characterize most counties where NHB people live and few counties where NHW or Mexican American people live.

Surprisingly, Mexican American men and women were more likely to have more than one partner where disassortative sex ratios were low, while associations with matched sex ratios were nonsignificant, in adjusted analyses. These associations may reflect more social contacts between Mexican Americans and non-Hispanic individuals than there is between races.⁶⁴ The greater likelihood of having more than one partner

Table 3 (continued). Logistic regression results for the odds of having had multiple partners in the past year by sex-ratio and correctional facility rate tertile groups among non-Hispanic black, non-Hispanic white, and Mexican American male and female participants, NHANES 1999–2004

Characteristic	Mexican American men		Mexican American women	
	OR (95% CI)	AOR ^a (95% CI)	OR (95% CI)	AOR ^a (95% CI)
Matched sex ratio ^b				
83.3 to 105.3	1.0 (0.6, 1.6)	0.7 (0.3, 1.4)	3.0 (1.3, 6.8) ^c	1.4 (0.4, 5.8)
105.4 to 114.1	0.8 (0.5, 1.1)	0.6 (0.3, 1.0)	1.8 (1.0, 3.4)	1.7 (0.9, 3.2)
114.2 to 196.8	1.0	1.0	1.0 ^d	1.0
Disassortative sex ratio ^e				
89.2 to 96.9	1.1 (0.7, 1.8)	1.4 (0.9, 2.2)	0.8 (0.4, 1.7)	3.8 (1.7, 8.5) ^g
97.0 to 100.0	1.2 (0.7, 1.9)	2.3 (1.1, 5.0) ^c	0.6 (0.3, 1.1)	0.7 (0.3, 1.6)
100.1 to 112.2	1.0	1.0	1.0	1.0 ^h
Correctional facility rate ^f				
0.0 to 89.8	1.0	1.0 ^d	1.0	1.0 ^d
89.9 to 145.4	1.1 (0.7, 1.8)	1.5 (0.9, 2.7)	1.5 (0.8, 3.2)	0.9 (0.5, 1.8)
145.5 to 1,628.2	1.2 (0.8, 2.0)	2.1 (1.2, 3.4) ^g	2.3 (1.3, 4.1) ^g	2.1 (1.1, 4.2) ^c

^aAORs are adjusted for data-collection wave, age group, marital status, place of birth, family income, geographic region, county size, poverty rate in the county of residence, and the other two characteristics in the table.

^bMatched sex ratio was calculated using the male and female population of the race/ethnicity of the participant in the county of residence.

^cDifferent from the reference group, $p < 0.05$

^dSatterthwaite-adjusted overall F-statistic significant at the $p < 0.05$ level

^eDisassortative sex ratio was calculated using the male and female population among racial/ethnic groups other than that of the participant in the county of residence.

^fCorrectional facility rate refers to the number of men in correctional facilities per 10,000 population of the race/ethnicity of the participant in the county of residence.

^gDifferent from the reference group, $p < 0.01$

^hSatterthwaite-adjusted overall F-statistic significant at the $p < 0.01$ level

NHANES = National Health and Nutrition Examination Survey

OR = odds ratio

CI = confidence interval

AOR = adjusted odds ratio

among Mexican American men and women in counties with the highest Mexican American male correctional facility rates may reflect greater partnership dissolution and, subsequently, increased partner availability, similar to the results for NHB men.

It is not clear why this association was significant among Mexican American women but not among NHB or NHW women. Several factors may confound racial/ethnic comparisons. For example, 62% of Mexican American men and 53% of Mexican American women were born outside of the U.S., compared with 10% or less among NHW and NHB men and women. Sex ratios and correctional facility rates varied less for NHW respondents than for the other groups. Still, NHW men in the middle correctional facility rate group were more likely to have five or more partners than those in the low correctional facility rate group, similar to results among NHB men. Correctional facility rates were positively associated with having two or more, or five or more partners among men of each racial/ethnic group studied. The lack of a significant association with matched sex ratios among women does not preclude the possibility that some women increase their number of male partners in response to low sex ratios, while others have fewer male partners or none.

Limitations

This study had several limitations. Participants may have underestimated or exaggerated their numbers of partners. In addition, data on other factors that are important for HIV/STI transmission, such as condom use in the past year, were not collected. Because NHANES was not designed to test contextual hypotheses, aspects of the design and sampling may have limited the reliability of the results. Additionally, in many counties, there were relatively small numbers of NHB people or Mexican Americans, precluding further stratification by age groups. Also, although the racial/ethnic differences found in matched sex-ratio and incarceration measures were themselves noteworthy, they made the comparison of effects at the same exposure levels impossible. Furthermore, results of analyses of data from Mexican Americans may not be generalizable to other Hispanic groups. In addition, because the Census counts inmates where the correctional facility is located, not where the offense occurred, the measure of incarceration may contain substantial error.

The number of partners may also be related to factors associated with sex ratios that were not assessed in this study. For example, Du Bois noted that Philadelphia and other cities had a shortage of black men relative to black women more than 100 years ago, which he attributed to greater employment opportunities for

Table 4. Logistic regression results for the odds of having had five or more partners in the past year by sex ratio and correctional facility rate tertile groups among non-Hispanic black, non-Hispanic white, and Mexican American male NHANES 1999–2004 participants

Characteristic	Non-Hispanic black men	
	OR (95% CI)	AOR ^a (95% CI)
Matched sex ratio ^b		
76.0 to 81.0	1.9 (1.0, 3.9)	2.4 (1.0, 5.8) ^c
81.1 to 83.7	3.1 (1.7, 5.6) ^d	4.1 (1.6, 10.0) ^d
83.8 to 137.3	1.0 ^e	1.0 ^f
Disassortative sex ratio ^g		
90.6 to 99.6	1.1 (0.6, 2.1)	0.5 (0.2, 1.1)
99.7 to 103.2	0.6 (0.3, 1.3)	0.5 (0.3, 1.1)
103.3 to 117.0	1.0	1.0
Correctional facility rate ^h		
42.3 to 299.9	1.0	1.0 ^e
300.0 to 496.5	2.3 (1.4, 3.9) ^d	2.1 (1.2, 3.6) ^c
496.6 to 2,753.0	1.5 (0.7, 3.1)	0.9 (0.5, 1.8)
	Non-Hispanic white men	
Characteristic	OR (95% CI)	AOR ^a (95% CI)
Matched sex ratio ^b		
89.9 to 98.0	0.9 (0.5, 1.7)	0.9 (0.4, 1.9)
98.1 to 100.2	1.2 (0.8, 2.0)	1.5 (0.7, 2.9)
100.3 to 111.8	1.0	1.0
Disassortative sex ratio ^g		
79.1 to 95.8	0.7 (0.4, 1.2)	0.7 (0.4, 1.2)
95.9 to 106.1	1.2 (0.7, 2.0)	1.0 (0.5, 2.0)
106.2 to 126.2	1.0	1.0
Correctional facility rate ^h		
10.2 to 44.4	1.0 ^f	1.0 ^e
44.5 to 64.0	2.5 (1.5, 4.2) ^d	3.3 (1.9, 5.9) ^d
64.1 to 1377.7	1.3 (0.6, 2.7)	1.2 (0.6, 2.7)

continued on p. 79

black women and greater employment discrimination toward black men.¹⁰ Recent work demonstrates that substantial employment discrimination still occurs.⁶⁵ Mortality rates for black males due to homicide and injuries are also high, relative to other groups.^{66,67}

CONCLUSION

Further research is needed to determine how these factors are related to male shortage or incarceration rates among NHB populations, and whether they are independently associated with the number of partners. Because the likelihood of HIV/STI transmission depends, in part, on the number of partners, it is important to determine the causal relationships among these associations to better understand racial/

Table 4 (continued). Logistic regression results for the odds of having had five or more partners in the past year by sex ratio and correctional facility rate tertile groups among non-Hispanic black, non-Hispanic white, and Mexican American male NHANES 1999–2004 participants

Characteristic	Mexican American men	
	OR (95% CI)	AOR ^a (95% CI)
Matched sex ratio ^b		
83.3 to 105.3	0.9 (0.4, 1.9)	0.9 (0.2, 4.3)
105.4 to 114.1	0.6 (0.2, 1.4)	0.6 (0.1, 2.5)
114.2 to 196.8	1.0	1.0
Disassortative sex ratio ^c		
89.2 to 96.9	1.8 (0.8, 3.8)	1.4 (0.6, 3.6)
97.0 to 100.0	1.2 (0.5, 2.9)	1.7 (0.4, 6.4)
100.1 to 112.2	1.0	1.0
Correctional facility rate ^d		
0.0 to 89.8	1.0	1.0
89.9 to 145.4	1.2 (0.5, 3.0)	1.8 (0.8, 4.1)
145.5 to 1,628.2	0.7 (0.4, 1.3)	0.9 (0.2, 3.4)

^aAORs are adjusted for data-collection wave, age group, marital status, place of birth, family income, geographic region, county size, poverty rate in the county of residence, and the other two characteristics in the table.

^bMatched sex ratio was calculated using the male and female population of the race/ethnicity of the participant in the county of residence.

^cDifferent from the reference group, $p < 0.05$

^dDifferent from the reference group, $p < 0.01$

^eSatterthwaite-adjusted overall F-statistic significant at the $p < 0.01$ level

^fSatterthwaite-adjusted overall F-statistic significant at the $p < 0.05$ level

^gDisassortative sex ratio was calculated using the male and female population among racial/ethnic groups other than that of the participant in the county of residence.

^hCorrectional facility rate refers to the number of men in correctional facilities per 10,000 population of the race/ethnicity of the participant in the county of residence.

NHANES = National Health and Nutrition Examination Survey

OR = odds ratio

CI = confidence interval

AOR = adjusted odds ratio

ethnic HIV/STI disparities and develop more effective prevention programs and interventions.

This study was undertaken in partial fulfillment of the requirements for a doctoral degree in epidemiology and public health at Yale University for one of the authors (E. Pouget). This research was funded by National Institute of Mental Health grants F31 MH081367 (principal investigator [PI]: E. Pouget), T32 MH020031 (PI: J. Ickovics), and P30 MH062294 (PI: P. Cleary).

The authors thank Deborah Rose and her colleagues at the National Center for Health Statistics, and Katrina L. Weingert and J. Gregory Robinson at the U.S. Census Bureau for their assistance.

REFERENCES

- HIV prevalence estimates—United States, 2006. *MMWR Morb Mortal Wkly Rep* 2008;57(39):1073-6.
- Centers for Disease Control and Prevention (US). Trends in reportable sexually transmitted diseases in the United States, 2007: national surveillance data for chlamydia, gonorrhea, and syphilis. Atlanta: CDC; 2008.
- Xu F, Sternberg MR, Kottiri BJ, McQuillan GM, Lee FK, Nahamias AJ, et al. Trends in herpes simplex virus type 1 and type 2 seroprevalence in the United States. *JAMA* 2006;296:964-73.
- Anderson RM, May RM. *Infectious diseases of humans: dynamics and control*. New York: Oxford University Press; 1991.
- Fryar CD, Hirsch R, Porter KS, Kottiri B, Brody DJ, Louis T. Drug use and sexual behaviors reported by adults: United States, 1999–2002. *Adv Data* 2007;384:1-14.
- Mosher WD, Chandra A, Jones J. Sexual behavior and selected health measures: men and women 15–44 years of age, United States, 2002. *Adv Data* 2005;362:1-55.
- Guttentag M, Secord PF. *Too many women? The sex ratio question*. Newbury Park (CA): Sage Publications; 1983.
- Pedersen FA. Secular trends in human sex ratios: their influence on individual and family behavior. *Hum Nat* 1991;2:271-91.
- Census Bureau (US). Population by age, sex, race, and Hispanic or Latino origin for the United States: 2000 (PHC-T-9) [cited 2009 Dec 27]. Available from: URL: <http://www.census.gov/population/www/cen2000/briefs/phc-t9/index.html>
- Du Bois WEB. *The Philadelphia Negro: a social study*. New York: Benjamin Blom; 1967.
- Kelley HH, Thibaut JW. *Interpersonal relations: a theory of interdependence*. New York: John Wiley & Sons; 1978.
- Thibaut JW, Kelley HH. *The social psychology of groups*. New York: John Wiley & Sons; 1959.
- Sprecher S. Social exchange theories and sexuality. *J Sex Res* 1998;35:32-43.
- Baumeister RF, Vohs KD. Sexual economics: sex as female resource for social exchange in heterosexual interactions. *Pers Soc Psychol Rev* 2004;8:339-63.
- Connell RW. *Gender and power: society, the person, and sexual politics*. Cambridge (UK): Polity Press in association with B. Blackwell; 1987.
- Barrow RY, Berkel C, Brooks LC, Groseclose SL, Johnson DB, Valentine JA. Traditional sexually transmitted disease prevention and control strategies: tailoring for African American communities. *Sex Transm Dis* 2008;35(12 Suppl):S30-9.
- DiClemente R, Wingood GM. A randomized controlled trial of an HIV sexual risk-reduction intervention for young African-American women. *JAMA* 1995;274:1271-6.
- Jemmott LS, Jemmott JB 3rd, O'Leary A. Effects on sexual risk behavior and STD rate of brief HIV/STD prevention interventions for African American women in primary care settings. *Am J Public Health* 2007;97:1034-40.
- Hogben M, Leichter JS. Social determinants and sexually transmitted disease disparities. *Sex Transm Dis* 2008;35(12 Suppl):S13-8.
- Cox OC. Sex ratio and marital status among Negroes. *Am Sociol Rev* 1940;5:937-47.
- Messner SF, Sampson RJ. The sex ratio, family disruption, and rates of violent crime: the paradox of demographic structure. *Soc Forces* 1991;69:693-713.
- Edlund L, Korn E. A theory of prostitution. *J Polit Econ* 2002;110:181-214.
- Tucker JD, Henderson GE, Wang TF, Huang YY, Parish W, Pan SM, et al. Surplus men, sex work, and the spread of HIV in China. *AIDS* 2005;19:539-47.
- Adimora AA, Schoenbach VJ, Martinson FE, Donaldson KH, Fulilove RE, Aral SO. Social context of sexual relationships among rural African Americans. *Sex Transm Dis* 2001;28:69-76.
- Adimora AA, Schoenbach VJ. Contextual factors and the black-white disparity in heterosexual HIV transmission. *Epidemiology* 2002;13:707-12.
- Adimora AA, Schoenbach VJ, Bonas DM, Martinson FE, Donaldson KH, Stancil TR. Concurrent sexual partnerships among women in the United States. *Epidemiology* 2002;13:320-7.
- Ferguson YO, Quinn SC, Eng E, Sandelowski M. The gender ratio imbalance and its relationship to risk of HIV/AIDS among African

- American women at historically black colleges and universities. *AIDS Care* 2006;18:323-31.
28. 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;15:319-35.
 29. Senn TE, Carey MP, Vanable PA, Seward DX. African American men's perceptions of power in intimate relationships. *Am J Mens Health* 2009;3:310-8.
 30. Thomas JC, Thomas KK. Things ain't what they ought to be: social forces underlying racial disparities in rates of sexually transmitted diseases in a rural North Carolina county. *Soc Sci Med* 1999;49:1075-84.
 31. 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;87:1937-43.
 32. 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* [serial online] 2008 May 16 [cited 2008 May 19]. Available from: URL: <http://www.springerlink.com/content/n2871320t54l735m>
 33. Fossett MA, Kiecolt KJ. A methodological review of the sex ratio: alternatives for comparative research. *J Marriage Fam* 1991;53:941-57.
 34. Schmitt DP. Sociosexuality from Argentina to Zimbabwe: a 48-nation study of sex, culture, and strategies of human mating. *Behav Brain Sci* 2005;28:247-311.
 35. Smith AM, Subramanian SV. Population contextual associations with heterosexual partner numbers: a multilevel analysis. *Sex Transm Infect* 2006;82:250-4.
 36. Benefo KD. Determinants of Zambian men's extra-marital sex: a multi-level analysis. *Arch Sex Behav* 2008;37:517-29.
 37. Freudenberg N. Jails, prisons, and health of urban populations: a review of the impact of the correctional system on community health. *J Urban Health* 2001;78:214-35.
 38. Hammett TM, Drachman-Jones A. HIV/AIDS, sexually transmitted diseases, and incarceration among women: national and southern perspectives. *Sex Transm Dis* 2006;33(7 Suppl):S17-22.
 39. Harman JJ, Smith VE, Egan LC. The impact of incarceration on intimate relationships. *Crim Justice Behav* 2007;34:794-815.
 40. Margolis AD, MacGowan RJ, Grinstead O, Sosman J, Kashif I, Flanigan TP, et al. Unprotected sex with multiple partners: implications for HIV prevention among young men with a history of incarceration. *Sex Transm Dis* 2006;33:175-80.
 41. Khan MR, Miller WC, Schoenbach VJ, Weir SS, Kaufman JS, Wohl DA, et al. Timing and duration of incarceration and high-risk sexual partnerships among African Americans in North Carolina. *Ann Epidemiol* 2008;18:403-10.
 42. Khan MR, Wohl DA, Weir SS, Adimora AA, Moseley C, Norcott K, et al. Incarceration and risky sexual partnerships in a southern US city. *J Urban Health* 2008;85:100-13.
 43. 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.
 44. Thomas JC, Levandowski BA, Isler MR, Torrone E, Wilson G. Incarceration and sexually transmitted infections: a neighborhood perspective. *J Urban Health* 2008;85:90-9.
 45. Johnson RC, Raphael S. The effects of male incarceration dynamics on AIDS infection rates among African-American women and men. National Poverty Center (NPC) working paper series: #06-22. Ann Arbor (MI): NPC; 2006. Also available from: URL: http://www.npc.umich.edu/publications/workingpaper06/paper22/working_paper06-22.pdf [cited 2007 Sep 21].
 46. Adimora AA, Schoenbach VJ, Martinson FE, Donaldson KH, Stancil TR, Fullilove RE. Concurrent partnerships among rural African Americans with recently reported heterosexually transmitted HIV infection. *J Acquir Immune Defic Syndr* 2003;34:423-9.
 47. Raj A, Reed E, Santana MC, Welles SL, Horsburgh CR, Flores SA, et al. History of incarceration and gang involvement are associated with recent sexually transmitted disease/HIV diagnosis in African American men. *J Acquir Immune Defic Syndr* 2008;47:131-4.
 48. Garnett GP. The transmission dynamics of sexually transmitted infections. In: Holmes KK, Sparling PF, Stamm WE, Piot P, Wasserheit JN, Corey L, et al., editors. *Sexually transmitted diseases*. 4th ed. New York: McGraw Hill; 2008. p. 27-39.
 49. Laumann EO, Youm Y. Racial/ethnic group differences in the prevalence of sexually transmitted diseases in the United States: a network explanation. *Sex Transm Dis* 1999;26:250-61.
 50. Buss DM. Human mate selection. *Am Sci* 1985;73:47-51.
 51. Morris M, Goodreau S, Moody J. Sexual networks, concurrency, and STD/HIV. In: Holmes KK, Sparling PF, Stamm WE, Piot P, Wasserheit JN, Corey L, et al., editors. *Sexually transmitted diseases*. 4th ed. New York: McGraw Hill; 2008. p. 109-25.
 52. Aral SO. Sexual risk behaviour and infection: epidemiological considerations. *Sex Transm Infect* 2004;80 Suppl 2:ii8-12.
 53. Brunham RC. Core group theory: a central concept in STD epidemiology. *Venerology* 1997;10:34-9.
 54. Garnett GP, Hughes JP, Anderson RM, Stoner BP, Aral SO, Whittington WL, et al. Sexual mixing patterns of patients attending sexually transmitted diseases clinics. *Sex Transm Dis* 1996;23:248-57.
 55. Robinson JG. ESCAP II: demographic analysis results. Executive Steering Committee for A.C.E. Policy II Report No. 1. Washington: Department of Commerce (US), Bureau of the Census; 2001. Also available from: URL: <http://www.census.gov/dmd/www/pdf/Report1.PDF> [cited 2008 Dec 20].
 56. Robinson JG, Adlakha A, West KK. Coverage of population in Census 2000: results from demographic analysis. Presented at the Annual Meeting of the Population Association of America; 2002 May 8-11; Atlanta.
 57. Research Triangle Institute. SUDAAN®: Version 9.0. Research Triangle Park (NC): Research Triangle Institute; 2004.
 58. National Center for Health Statistics (US). Analytic and reporting guidelines: the National Health and Nutrition Examination Survey (NHANES). Hyattsville (MD): NCHS; 2006.
 59. National Center for Health Statistics (US). Analytic and reporting guidelines: the Third National Health and Nutrition Examination Survey (NHANES III), 1988-94. Hyattsville (MD): NCHS; 1996.
 60. Research Triangle Institute. SUDAAN®: Version 9.0 user's manual. Research Triangle Park (NC): Research Triangle Institute; 2004.
 61. Hosmer DW, Lemeshow S. *Applied logistic regression*. 2nd ed. Hoboken (NJ): John Wiley & Sons, Inc.; 2000.
 62. SAS® Institute, Inc. The GLIMMIX procedure, June 2006 [cited 2007 Mar 12]. Available from: URL: <http://support.sas.com/rnd/app/papers/glimmix.pdf>
 63. Thomas JC, Torrone EA, Browning CR. Neighborhood factors affecting rates of sexually transmitted diseases in Chicago. *J Urban Health* 2010;87:102-12.
 64. Harris DR, Ono H. How many interracial marriages would there be if all groups were of equal size in all places? A new look at national estimates of interracial marriage. *Soc Sci Res* 2005;34:236-51.
 65. Pager D. *Marked: race, crime, and finding work in an era of mass incarceration*. Chicago: University of Chicago Press; 2007.
 66. Aragón TJ, Lichtensztajn DY, Katcher BS, Reiter R, Katz MH. Calculating expected years of life lost for assessing local ethnic disparities in causes of premature death. *BMC Public Health* 2008;8:116.
 67. Satcher D, Fryer GE, McCann J, Troutman A, Woolf SH, Rust G. What if we were equal? A comparison of the black-white mortality gap in 1960 and 2000. *Health Aff (Millwood)* 2005;24:459-64.