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## Social Network Characteristics and HIV Risk among African American, Asian/Pacific Islander, and Latino Men Who Have Sex with Men

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### Abstract

**Objectives**—To examine how social networks influence HIV risk among U.S. racial/ethnic minority men who have sex with men (MSM) and whether the associations of social network characteristics with risk vary by race/ethnicity.

**Methods**—A chain-referral sample of 403 African American, 393 Asian/Pacific Islander, and 400 Latino MSM recruited in Los Angeles County, CA completed a questionnaire, which asked about their egocentric social networks, safer sex peer norms, and male anal intercourse partners. HIV-nonconcordant partnerships were those reported by respondents as serodiscordant or where self and/or partner serostatus was unknown.

**Results**—Overall, 26% of the sample reported HIV-nonconcordant unprotected anal intercourse (UAI) with a non-primary male partner in the prior six months. In a GEE logistic model that controlled for race/ethnicity, age, nativity, incarceration history, and HIV status, being in a more dense network was associated with less HIV-nonconcordant UAI (adjusted odds ratio [AOR]=0.92, 95% confidence interval [CI]=0.86–0.99, p=0.0467). In addition, the effect of safer sex peer norms on HIV-nonconcordant UAI was moderated by ego-alter closeness (p=0.0021). Safer sex peer norms were protective among those reporting “medium” or “high” ego-alter closeness (AOR=0.70, 95% CI=0.52–0.95, p=0.0213 and AOR=0.48, 95% CI=0.35–0.66, p<0.0001, respectively), but not among those reporting “low” ego-alter closeness (AOR=0.96, 95% CI=0.63–1.46, p=0.8333). The effects of density, closeness, and norms on HIV-nonconcordant UAI did not differ by race/ethnicity.

**Conclusions**—The significant association of social network characteristics with UAI point to network-level factors as important loci for both ongoing research and HIV prevention interventions among U.S. MSM of color.

### Keywords

Social networks; HIV risk; men who have sex with men; African American; Asian and Pacific Islander; Latino

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## INTRODUCTION

Men who have sex with men (MSM) continue to bear the most severe HIV disease burden in the United States, well into the fourth decade of the AIDS epidemic. In 2009, MSM comprised almost two thirds (61%) of the estimated 45,369 new HIV infections compared to 27% for heterosexuals and 9% for injection drug users.<sup>1-3</sup> At the end of 2009, MSM accounted for more than half (51%) of the estimated 784,701 persons living with an HIV diagnosis compared to 26% for heterosexuals and 16% for injection drug users.<sup>1,3</sup> Among all MSM, Whites, African Americans, and Latinos accounted for 39%, 37%, and 20% of the new HIV infections in 2009, respectively.<sup>3</sup>

Social networks can affect HIV risk by diffusing information, norms, social support, and influence through social ties.<sup>4,5</sup> Empirical studies have shown that the structural (e.g., size, density), compositional (e.g., role relationship, strength of ties), and functional characteristics (e.g., norms, support) of social networks are associated with HIV-related risk behaviors including injection drug use,<sup>6,7</sup> drug equipment sharing,<sup>8-12</sup> condom use,<sup>13-16</sup> and unprotected sex.<sup>17-22</sup> Although the main effects of various network-level factors on HIV risk are well documented, the precise mechanisms through which these factors have their effect on risk remain unknown.<sup>11</sup> For example, safer sex norms<sup>14-16,23</sup> and strength of ties<sup>12,24</sup> each have been found to be associated with HIV-related risk behaviors. However, whether the effect of safer sex norms is moderated by strength of ties within a network has not been fully explored. It may be that safer sex norms affect sexual risk for HIV among people who have strong ties with their network members, but not among those who have weak ties with their network members as social influence diffuses more efficiently through strong ties rather than through weak ties,<sup>12</sup> and vice versa for diffusion of information.<sup>25</sup> Investigating the interaction between network structure, composition, and function may help identify different combinations of network-level factors that can be targeted to reduce HIV-related risk behaviors.<sup>11</sup>

The role of social networks in determining HIV risk has been examined among U.S. MSM.<sup>17,19-23,26,27</sup> However, whether social network characteristics and their association with risk vary across race/ethnicity in this population remains unknown. Prior social network studies of U.S. MSM have either focused on a single group,<sup>17,19,23,26</sup> or not compared multiple racial/ethnic groups simultaneously.<sup>20-22,27</sup>

The study presented in this paper examines the social network characteristics and HIV risk among African American, Asian/Pacific Islander, and Latino MSM living in Los Angeles, California. The study was designed to answer four questions: (1) Are the structural, compositional, and functional characteristics of social networks the same or different across these three racial/ethnic groups?; (2) Which types of social network characteristics are associated with sexual risk behavior?; (3) How do these social network characteristics interact to affect sexual risk behavior?; and (4) Do the associations of social network characteristics with sexual risk behavior vary by race/ethnicity?

## METHODS

### Procedures

We used data from the Ethnic Minority Men's Health Study designed to examine the impact of experiences of social discrimination, sexual partnerships, and social networks on sexual risk for HIV among African American, Asian/Pacific Islander, and Latino MSM. A chain-referral sample of participants was recruited in Los Angeles County, CA from May 2008 to October 2009. Eligibility for the study included: (1) self-identifying as male; (2) self-identifying as African-American, Asian/Pacific Islander, or Latino; (3) being at least 18

years old; (4) being a resident of Los Angeles County; (5) having had sex with at least one man in the last six months; and (6) not having participated in prior phases of this study that involved qualitative interviews and survey instrument piloting.

We first recruited “seeds” through referrals from project staff as well as outreach activities at MSM venues such as bars, dance clubs, and coffee shops. After providing written informed consent, eligible seed participants completed a one-hour, standardized questionnaire using an audio computer-assisted self-interviewing (ACASI) system. Following this, each seed participant received \$50 for compensation and was given three “recruitment coupons” to pass out to their eligible MSM friends or acquaintances. For every coupon redeemed, the seed participant received \$10.

The potential recruits who received the coupon from their seed participant contacted the study staff by telephone and their eligibility was determined during this telephone call. When eligible recruits came to our study site with a valid coupon, they completed the identical ACASI-based survey and each received in turn three coupons by which to recruit their MSM friends or acquaintances. This recruitment and enrollment process was repeated to generate our target sample size of approximately 400 for each ethnic group.

The Committee for Human Research of the University of California, San Francisco and the Institutional Review Board of AIDS Project Los Angeles approved the study procedures.

## Measures

Respondents were asked about their race/ethnicity, age, level of education, nativity, sexual orientation, lifetime incarceration history, and most recent HIV test result. The respondents were also asked about sexual behaviors with up to their 10 most recent sexual partners during the six months prior to interview. For each partner, questions included biological sex, HIV serostatus, counts of anal and vaginal sex episodes, condom use during each of these sexual episodes, and relationship type.

Our measure of sexual risk was based upon two considerations of the partnerships in which unprotected anal intercourse (UAI) occurred. We focused on potential HIV serodiscordance of the members of such partnerships; we also considered how the respondent defined the type of relationship they had with the sexual partner. Partnerships were considered HIV-nonconcordant if the respondent reported HIV-serodiscordance or the respondent did not know that serostatus of at least one member of the partnership. Sexual risk for HIV for this study was defined as having HIV-nonconcordant unprotected anal intercourse (UAI) in the past six months with at least one non-primary male partner with whom the respondent felt no special commitment. Those non-primary partners included “steady” partners with whom the respondent had had sex at least three times, “non-steady” partners with whom the respondent had had sex one or two times and knew prior to having sex, and casual/anonymous partners whom the respondent did not know prior to their sexual encounter. We focused on non-primary partners rather than on all male partners as a large proportion of new HIV infections continue to occur as a result of non-primary partnerships,<sup>28,29</sup> although other research findings suggest a growing number of seroconversions occurring within main relationships, especially among younger MSM.<sup>30</sup> In addition, serodiscordant partnerships in our dataset were in large part those in which at least one member’s HIV status was unknown (consistent with other findings, e.g., Halkitis et al., 2004;<sup>31</sup> van Kesteren et al., 2007).<sup>32</sup> It is with such non-primary sexual contacts that HIV status is least likely to be known.<sup>33–36</sup>

Safer sex peer norms were measured with a four-item scale (e.g., My friends and close acquaintances would never have unprotected anal sex with a casual or non-primary sex

partner; My friends and close acquaintances talk with one another about the importance of avoiding HIV transmission; Cronbach's  $\alpha=0.89$ ). Response to each item was scored on a four-point Likert scale (1="strongly disagree," 2 "somewhat disagree," 3="somewhat agree," 4="strongly agree"). Response scores were averaged to create the safer sex peer norms scale.

Egocentric social networks were enumerated by using three name generator questions. Respondents (the ego) were asked to name up to five adults (the alters) with whom they had most often spent free time in the past six months (i.e., contact networks), followed by naming up to five adults with whom respondents had discussed important matters in the past six months (i.e., discussion networks), and naming up to five adults who had influenced important decisions made in the past six months (i.e., influence networks). When asked about discussion and influence networks, respondents indicated whether any of the members had already been named in response to preceding name generators. For each respondent, the set of unique alters was compiled across the three name generators. The respondent indicated how close he felt to each alter (1="not at all close," 2="a little bit close," 3="moderately close," 4="very close"). Respondents also indicated whether each pair of alters were strangers or were especially close.

For each respondent, network size was calculated by summing the unique alters across the three network types; the maximum possible size equaled 15. Density of network alters was calculated as the average tie strength across all pairs of alters (range, 0–1; strangers counted as 0, intermediate closeness as  $\frac{1}{2}$ , and especially close ties as 1). Strength of ties between each ego and his alters was calculated as the average of the closeness ratings (range, 1–4). We then created a coarsened three-category, ego-alter closeness variable: low (average closeness less than 3), medium (average closeness between 3 and 3.5), and high (average closeness greater than 3.5).

### Statistical Analysis

Because alter density is undefined in egocentric networks of size zero or one, we fit regression models to the sub-sample of respondents reporting two or more social network members. The binary outcome describing any nonconcordant UAI with a non-primary partner was regressed on four social network indicators describing network size, alter density, categorical ego-alter closeness, and safer sex norms as well as indicators of respondent race/ethnicity and six respondent covariates (i.e., age, nativity, educational attainment, sexual orientation, incarceration history, and HIV status). Estimation was via a GEE logistic model with respondents clustered within recruitment seeds. Initially, the model considered all 2- and 3-way interactions between the social network indicators and race/ethnicity. A backward elimination process removed nonsignificant effects:  $p > 0.15$  for main effects and  $p > 0.05$  for interaction effects: at each step no effect was eligible for removal if it was contained within a higher-order effect in the model. To help determine whether any effects of social network variables might be attributable to social network members who were also sexual partners, a follow-up analysis repeated the modeling process after recalculating the network size, alter density, and ego-alter closeness variables and after dropping any social network members with whom they reported ever having anal/vaginal sex. All continuous explanatory variables were grand-mean centered prior to modeling. Regression models were fit to 20 multiply imputed data sets created via Markov Chain Monte Carlo.<sup>37</sup> All parameter and standard error estimates as well as statistical tests were calculated by combining results across the imputed data sets.<sup>37,38</sup>

## RESULTS

We enrolled a total of 1,196 participants. Of these participants, 453 were seeds and 722 were recruited by seeds. The number of recruitment waves completed by each seed ranged from 0 to 14. The mean and median number of participants referred by a seed and his recruits was 1 and 0, respectively (range=0–125).

### Respondent characteristics

Table 1 presents respondent characteristics both for the whole sample (N=1,196) and by race/ethnicity. African Americans tended to be older and were more likely to self-identify as bisexual. Asians/Pacific Islanders were most likely to have a college degree and to be foreign born. African Americans and Latinos were more likely to have a lifetime history of incarceration and to report being HIV-positive. With respect to sexual behavior, the three racial/ethnic groups reported similar proportions of having HIV-nonconcordant UAI with a non-primary male partner in the past six months.

### Characteristics of social networks

The mean size and alter density of social networks for the whole sample (N=1,196) were 6 and 0.41, respectively (Table 2). The mean ego-alter closeness was 3.2. The mean safer sex norms scale score was 2.71, roughly at the scale mid-point. There were no statistically significant differences in network size, ego-alter closeness, and safer sex norms by race/ethnicity. However, Asians/Pacific Islanders tended to have less dense networks.

### Associations of social network characteristics with UAI

We conducted multivariate analyses to examine the associations of social network characteristics with HIV-nonconcordant UAI in the sub-sample of respondents who reported two or more social network members including sex partners who respondents named in their social networks (N=1,138). We repeated the same analyses after excluding sex partners named in the respondents' social networks and recalculating network size, ego-alter closeness, and alter density (N=1,013). Because the results from both of the analyses were highly similar, we report only the initial multivariate model that retained data on all social network members. Table 3 shows all modeled effects that were retrained after backward elimination. The main effect for alter density was negative and statistically significant; controlling for race/ethnicity, age, nativity, incarceration history, HIV status, ego-alter closeness, and safer sex peer norms, a 0.10 change in alter density was negatively associated with HIV-nonconcordant UAI (adjusted odds ratio [AOR]=0.92, 95% confidence interval [CI]=0.86–0.99,  $p=0.0467$ ). In summary, those who were in more dense networks were less likely to engage in HIV-nonconcordant UAI.

The effect of safer sex peer norms on HIV-nonconcordant UAI was significantly moderated by ego-alter closeness ( $p=0.0021$ ). To help interpret this interaction, we report the main effect of safer sex peer norms at each level of ego-alter closeness. Among those reporting “low” ego-alter closeness, the safer sex peer norms measure was unrelated to the outcome (AOR=0.96, 95% CI=0.63–1.46,  $p=0.8333$ ). However, with increasing ego-alter closeness, a protective effect of safer sex peer norms became more pronounced (AOR=0.70, 95% CI=0.52–0.95,  $p=0.0213$  and AOR=0.48, 95% CI=0.35–0.66,  $p<0.0001$ , for the “medium” and “high” ego-alter closeness, respectively). To add further insight into this interaction effect, we examined levels of HIV-nonconcordant UAI by ego-alter closeness and safer sex peer norms after dichotomizing the safer sex peer norms variable into “low” and “high” (the scale score 2.5 or less and greater than 2.5, respectively). Figure 1 shows that the combinations of “medium” or “high” ego-alter closeness and lower safer sex peer norms were related to increased risk (35% and 43%, respectively). Conversely, reported risk levels

among those with “low” ego-alter closeness or higher safer sex peer norms were roughly equivalent, ranging from 19% to 22%.

For completeness, we also report the main effect of ego-alter closeness. Because it was a component of an interaction effect, the main effect of closeness is dependent upon the level of safer sex peer norms. Here we report the main effect of ego-alter closeness estimated at the mean value of safer sex peer norms: compared to those with a low level of ego-alter closeness, respondents with a medium or high level of ego-alter closeness were more likely to engage in HIV-nonconcordant UAI (AOR=1.67, 95% CI=1.06–2.62,  $p=0.0271$  and AOR=1.87, 95% CI=1.14–3.06,  $p=0.0137$ , respectively). We re-emphasize that because of the modeled interaction term, these odds ratios describe effects that are specific to the safer sex peer norms mean value.

Besides the two-way interaction between ego-alter closeness and safer sex peer norms described above, no other two-way interactions between the four social network indicators were statistically significant at  $p < 0.05$ . Also, we found no statistically significant moderating effect of race/ethnicity for the associations between social network characteristics and HIV-nonconcordant UAI. None of the three-way interactions between the social network indicators and race/ethnicity were statistically significant at  $p < 0.05$ .

## Discussion

This study set out to examine social network characteristics among MSM of color and their associations to sexual risk for HIV. We were specifically interested in examining similarities and differences among African American, Asian/Pacific Islander, and Latino MSM in the associations and the interactions explored. We found that structural, compositional, and functional social networks characteristics examined in this study were mostly similar across these three racial/ethnic groups. Further, the significant associations that we found between these social network characteristics and sexual risk behavior did not vary significantly by race/ethnicity.

Prior research has shown a significant association between network size and HIV-related risk behaviors.<sup>6,8,9,22,27</sup> For example, Carlos et al. found that a larger network size was associated with more frequent UAI with non-primary partners among African American and Latino MSM.<sup>22</sup> In our sample of African American, Asian/Pacific Islander, and Latino MSM, we did not find such a positive association. The network size examined in this study had little impact on HIV-nonconcordant UAI with non-primary sex partners. This inconsistent finding may be attributable to a difference in the assessment of social networks. Whereas Carlos et al. focused on MSM social networks,<sup>22</sup> our enumeration of social networks was broader and included both MSM and non-MSM network members. A possible reason for the minimal impact of network size on sexual risk found in our study may be a function of the relationship between availability of sexual partners to the size of each type of network. It may be that the larger one’s social network of MSM, the greater the pool of potential non-primary sexual partners and therefore, expanded opportunities for unprotected sex. By comparison, the size of social network may matter less when networks are mixed (MSM and non-MSM), because these networks may produce fewer sexual opportunities, including opportunities for unprotected sex

Consistent with prior research conducted with MSM,<sup>39</sup> we found that network density had a protective effect for sexual risk behavior. HIV-nonconcordant UAI was less frequent among men with more dense social networks. As noted by others,<sup>39,40</sup> more dense networks, in which more members know one another, may provide more opportunities for monitoring and sanctioning social network members’ behaviors, which, in turn, may make the members

more likely to conform to what is perceived as socially acceptable safer sex behavior. Specifically, in the case of MSM of color, social network density may be an important factor to consider in relation to sexual risk behavior because how one comports oneself matters to closely connected members of social networks who share personal information.

We investigated the interacting roles of social network structure (size, density), composition (closeness), and function (norms) in determining sexual risk for HIV among of MSM of color. We found no statistically significant interactions between network structure and composition and function. However, we found a statistically significant interaction between network composition and function. Specifically, we found the significant negative association between safer sex peer norms and UAI in our sample of MSM of color, which is consistent with prior studies,<sup>23,41</sup> but this association varied by ego-alter closeness. Safer sex peer norms had a protective effect for men who reported “medium” and “high” ego-alter closeness, but not for those who reported “low” ego-alter closeness. Moreover, safer sex peer norms were more protective among those who reported “high” ego-alter closeness. We also found that HIV risk levels were highest among those who reported “high” ego-alter closeness and had lower safer sex peer norms, followed by those who reported “medium” ego-alter closeness and had lower safer sex peer norms. These findings support the notion that strong ties, as opposed to weak ties, are more efficient in disseminating social influence.<sup>12,25</sup> This would suggest that HIV prevention interventions which focus solely on dissemination of safer sex norms within communities of MSM of color are insufficient to insure reductions in sexual risk behavior. To buttress safer sex norms, interventions focused on building social connectedness should be supported and evaluated. For MSM of color, these types of interventions may be more culturally salient (and therefore more effective) because they reinforce the importance of family, collectivism and community in the promotion of self-care and health behaviors.<sup>42-44</sup>

The findings of this study should be interpreted with caution. First, the study findings may not generalize to the broader community of African American, Asian/Pacific Islander, and Latino MSM in Los Angeles County, CA because our sample was not selected randomly. Second, respondents’ self-reports of sexual behavior may be subject to recall and social desirability bias. Third, as we collected only egocentric network data (respondent reports of the social network members to whom he had direct links), rather than sociometric network data (from all social network members), some of the network characteristics as reported by respondents, (i.e., alter density, ego-alter closeness) might not reflect the true nature of relationships between ego and alters as well as between alters. Fourth, our study was cross-sectional and thus causality cannot be established for the observed effects of social network characteristics on sexual risk behaviors. More studies with MSM of color should be conducted to corroborate our study findings.

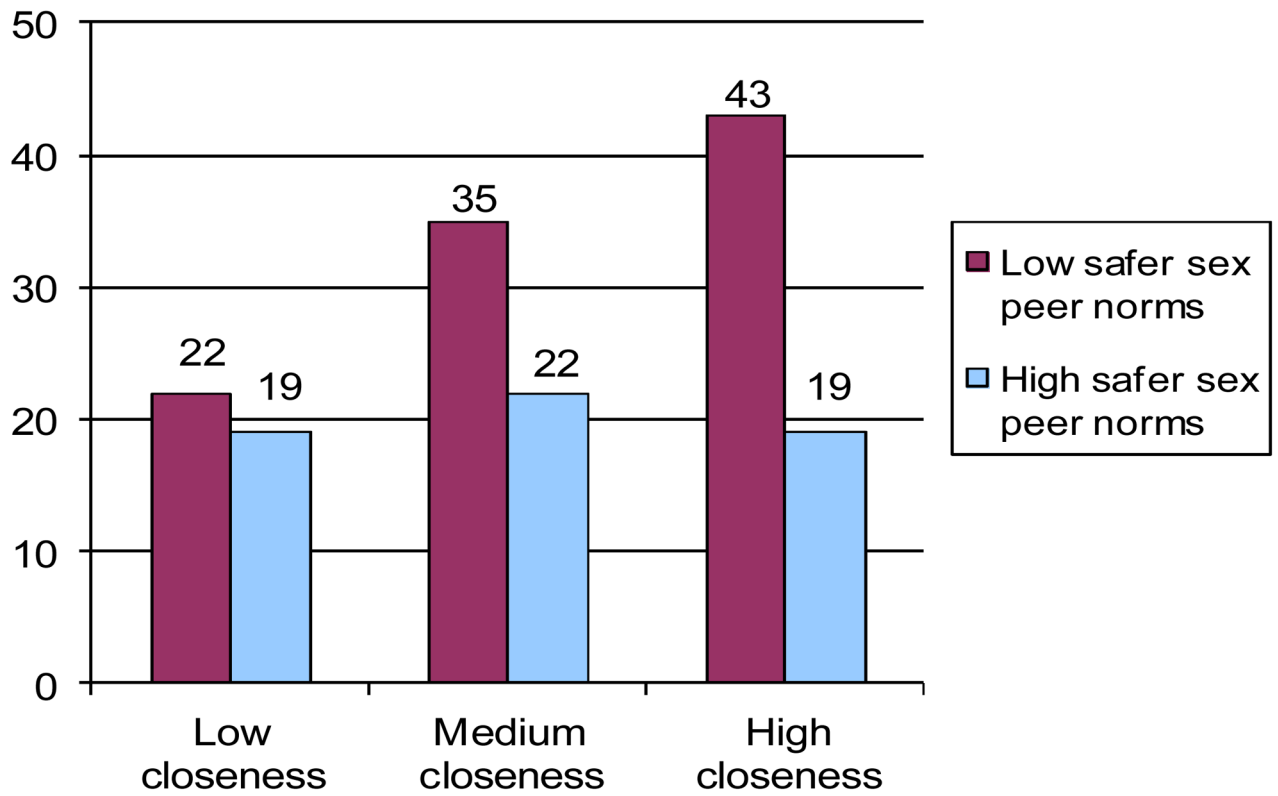
Nevertheless, to our knowledge, this was the first study that described and compared social networks across the three groups of MSM of color with a relatively large sample of men, particularly Asians/Pacific Islanders, and that documented the interacting roles of social network characteristics in determining sexual risk for HIV. It provides a fertile basis for continued work in this area to both sharpen our understandings of the impact of social network factors on sexual risk behavior, and refine risk reduction interventions for MSM of color. At present, there is no systematically evaluated HIV prevention or sexual health approach for which the locus of intervention is the social networks of MSM of color. Understanding social network characteristics (such as ego-alter closeness) and how they influence safer sex peer norms and sexual risk for HIV provides a valuable starting point. Additional research into this area is urgently needed and would be greatly welcomed, given the heavy HIV disease burden being shouldered by this group.



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**FIGURE 1.**  
Percentages of Participants Who Reported Unprotected Anal Intercourse in the Past Six Months, by Ego-Alter Closeness and Safer Sex Peer Norms

TABLE 1

## Respondent Characteristics, by Race/Ethnicity

Characteristics	African American (N=403)	Asian/Pacific Islander (N=393)	Latino (N=400)	Overall (N=1196)
Age (mean in years; range: 18–83) ***	41	33	35	36
Education (%) ***				
Less than high school diploma	14	4	22	13
High school diploma or GED	37	13	27	26
Some college education	35	23	29	29
College graduate	14	60	21	32
Nativity (%) ***				
U.S. born	94	43	61	66
Foreign born	6	57	39	34
Sexual orientation (%) ***				
Gay	60	86	77	74
Bisexual	27	11	17	19
Other	13	3	6	7
Lifetime incarceration history ***	41	13	35	29
Self-reported HIV serotatus (%) ***				
Positive	51	14	44	36
Negative/unknown	49	86	56	64
Having HIV-nonconcordant unprotected anal intercourse with non-primary male partners in the past 6 months	23	28	25	26

\*\*\*  
p < 0.001

**TABLE 2**

## Social Network Characteristics, by Race/Ethnicity

Characteristics	African American (N=403)	Asian/Pacific Islander (N=393)	Latino (N=400)	Overall (N=1196)
Mean number of network members (range = 0 – 15)	6.1	5.9	6.1	6.0
Number of network members (%)				
0	1	2	1	1
1	3	5	3	4
2	7	6	9	7
3 – 5	36	33	30	33
6–10	43	48	48	47
11–15	10	6	9	8
Mean alter density (range = 0 – 1)*	0.42	0.38	0.42	0.41
Mean ego-alter closeness (range = 1 – 4)	3.24	3.28	3.22	3.24
Mean safer sex peer norms scale score (range = 1 – 4)	2.70	2.78	2.67	2.71

\* p &lt; 0.05

**TABLE 3**

Associations of Social Network Characteristics with HIV-nonconcordant Unprotected Anal Intercourse with a Non-primary Male Partners in the Prior Six Months: Results of GEE Multiple Logistic Regression Analysis<sup>1</sup> (N=1138)

	Adjusted Odds Ratio (95% Confidence Interval)	p-value
Alter density (per 10% increase)	0.92 (0.86, 0.99)	0.0467
Interaction between safer sex peer norms and ego-alter closeness		
Norms at low closeness	0.96 (0.63, 1.46)	0.8333
Norms at medium closeness	0.70 (0.52, 0.95)	0.0213
Norms at high closeness	0.48 (0.35, 0.66)	<0.0001
Ego-alter closeness at the mean level of safer sex peer norms		
Medium vs. low closeness	1.67 (1.06, 2.62)	0.0271
High vs. low closeness	1.87 (1.14, 3.06)	0.0137

<sup>1</sup>Final model retained race/ethnicity, age, nativity, lifetime history of incarceration, and HIV status ( $p = 0.15$ ; data not shown); the final model removed main effects of network size, respondent educational attainment, and respondent sexual orientation ( $p > 0.15$ ) as well as all interaction terms other than the interaction between safer sex peer norms and ego-alter closeness ( $p > 0.05$ ); the intra-cluster correlation was near zero and negative;  $-0.0023$ .