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High prevalence of sexual concurrency and concurrent unprotected anal intercourse across racial/ethnic groups among a national, web-based study of men who have sex with men in the United States

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Abstract

Background—Men who have sex with men (MSM) are the largest HIV risk-group in the United States. Sexual concurrency may contribute to high HIV incidence, or to racial/ethnic HIV disparities among MSM. Limited information is available on concurrency and racial/ethnic differences among MSM, or on the extent to which MSM engage in concurrent unprotected anal intercourse (UAI).

Methods—Data are from baseline responses in a prospective online study of MSM aged ≥ 18 years, having ≥ 1 male sex partner in the past 12 months, and recruited from social networking websites. Pair-wise sexual concurrency and UAI in the previous 6 months among up to 5 recent partners was measured, using an interactive questionnaire. Period prevalences of concurrency and concurrent UAI were computed and compared across racial/ethnic groups at the individual and triad (a respondent and 2 sex partners) levels.

Results—2,940 MSM reported on 8,911 partnerships; 45% indicated concurrent partnerships and 16% indicated concurrent UAI in the previous 6 months. Respondents were more likely to have UAI with two partners when they were concurrent, compared to serially monogamous (OR [95% CI] = 1.93 [1.75, 2.14]). No significant differences in levels of individual concurrency or concurrency among triads were found between non-Hispanic white, non-Hispanic black, and Hispanic men.

Conclusions—Concurrency and concurrent UAI in the previous 6 months was common. Although there were no differences by race/ethnicity, the high levels of concurrency and concurrent UAI may be catalyzing the transmission of HIV among MSM in general.

Keywords

Concurrency; MSM; sexual networks; UAI; racial disparities

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Conflicts of Interest:
The authors have no conflicts of interest to declare.

Introduction

In 2009, men who have sex with men (MSM) were the group most represented among new HIV infections (61%) and individuals living with HIV (55%) in the United States [1,2]. Furthermore, since 2000, MSM have been the only transmission group in which incident HIV cases have increased [1,3,4].

In addition to the disparities between MSM and other HIV risk-groups, there are substantial disparities among MSM. Estimates of both prevalence and incidence are consistently higher among black and Hispanic MSM, compared to white MSM, with young black MSM facing the greatest disparity in HIV incidence [2,5].

The reasons that MSM of color are more at risk for HIV infection are unclear. Studies of individual-level risk factors have consistently revealed equivalent or lower levels of such behaviors among men of color [6,7] . Differential sexual network properties have been hypothesized as a contributor to this disparity, although the published data are limited. Sexual concurrency, defined as "overlapping sexual partnerships where sexual intercourse with one partner occurs between two acts of intercourse with another partner" [8], is thought to be an important catalyst of HIV transmission. This is because concurrency increases the exposure of one's partners to each other and increases the likelihood that a newly infected individual would transmit HIV to an uninfected partner during the highly infectious acute period of HIV infection [9,10]. Concurrency has been demonstrated in simulations of US heterosexuals to accelerate HIV/STI transmission and drive racial disparities [11,12], and networks factors such as concurrency have been suggested possible determinants of the racial disparity among MSM in the US [6].

Concurrency may contribute to the disparities seen in the US HIV epidemics yet remains little studied empirically among MSM [13]. Among predominantly heterosexual men in the US sampled from 2002–2003, Adimora et al found a 12-month period prevalence of concurrency of 11% and 14% among those reporting at least one sex partner [14]. Only one report has been published on the prevalence of concurrency among MSM, by race/ethnicity [15]. In that study of MSM in San Francisco, among those with multiple sex partners, 65% of white men reported concurrency, compared to 56% of black men. These results are limited by the measure of concurrency used, which considered partnerships close in time but not necessarily overlapping to be concurrent and thus may have misclassified serial monogamy as concurrency. They are further limited by the small number of black MSM (n = 18), and the restriction to one US city.

Three key methodological gaps have traditionally precluded accurate empirical understandings of concurrency: those of measuring concurrency accurately, at the appropriate levels of analysis, and with the incorporation of risk behavior.

Participant concurrency response data have traditionally been collected in several ways, all of which have limitations and limited agreement with one another [16,17]. The theoretically most precise method is to gather dates of first and last sex for participants' named sex partners and examine the resulting intervals for overlaps. Yet this is subject to errors in recall and logical inconsistencies. Others have asked for these dates at the one-month level of detail, but this results in temporal ambiguities and misclassification of concurrency, particularly for short-term casual relationships [14,16,18]. Another method is to directly ask a participant, for each of his/her partners, about the existence of concurrent partners, but this precludes an understanding of partner sequencing and of the other concurrent partners involved [16,19] and ultimately limits the understanding of concurrency.

The level of analysis of concurrency may be important to understanding the possible impact of concurrency within sexual networks. Concurrency is most often described at the individual study participant level, but there is another level which is more relevant to understanding HIV transmission dynamics: the triad. Triads are the level at which concurrency's bidirectional transmission potential acts and represent the unit of an individual and two of his/her sex partners (aka: partnership pair). Yet information may be lost when summarizing an individual's sexual history across triads, rendering this an insufficient measure for prevention applications. This is because individuals may be concurrent with only certain pairs of partners, and may differentially contribute to community transmission risk based on the number and types of concurrent triads they have. One may gain a better understanding of the features associated with concurrent partnerships and their contribution to community risk, if concurrency is analyzed at the triadic level.

Further, most reports have focused on quantifying the prevalence of concurrency, irrespective of dyadic risk behaviors. This alone is insufficient to describe the potential increase in disease transmission associated with concurrency since condoms may be used with one or both of the sex partners involved. In a triad, if condoms are used consistently and completely with either or both partners, then the attendant concurrency is irrelevant to network transmission dynamics. There is a need to understand biologically relevant concurrency – that is, triads in which incomplete condom use with both partners actually enables disease transmission.

However, biologically relevant concurrency has been seldom measured or described at either the participant or triad levels. Descriptions of concurrency at the triadic level or that incorporate condom use are scant. Doherty et al [20] have published the only findings on biologically relevant concurrency among triads from the US heterosexual data described above, and found that among these men, 28% of concurrent triads involved unprotected vaginal intercourse with both partners. To date, no data have been published on biologically relevant concurrency or concurrency at the triadic level among MSM.

In this work, we seek to quantify the prevalence of concurrency among MSM, by race/ethnicity, in a national online study of MSM in the United States. To do so accurately and robustly, we address the above methodological gaps by using an improved concurrency measurement tool [21], quantify both concurrency and concurrent UAI, and conduct analyses at both at the individual and triadic levels.

Materials and Methods

Study design

Data come from the baseline responses of a 12-month prospective online study of HIV behavioral risks among MSM in the United States, being conducted by Emory University. Internet-using MSM were recruited from August – December 2010 through selective placement of banner advertisements on websites [22]. In order to attain the broadest sample of online MSM, the majority of respondents were recruited from social networking websites (eg: Facebook, MySpace, although limited recruitment occurred on one dating website. No other dating or hookup sites were included, in order to avoid over-sampling higher-risk MSM. Men who clicked on the advertisements were taken to an online eligibility screening survey. Eligible individuals for the baseline questionnaire were male, at least 18 years of age, and had a male sex partner in the past 12 months. Following the administration of an online consent document, participants completed a 60-minute questionnaire. The study was reviewed and approved by the Institutional Review Board of Emory University.

To allow testing of race/ethnicity-related hypotheses with adequate power, this analysis includes only white non-Hispanic, black non-Hispanic, and Hispanic respondents. The questionnaire's dyadic sexual behaviors module was oriented about a 6-month recall period and thus we further restricted our analysis to the 91% of respondents who additionally had sex within the previous 6 months.

Sexual concurrency and partnership data collection

Participants who had a sex partner within 6 months were asked to provide nicknames for up to 5 most recent anal, oral, or vaginal sex partners within the previous 6 months, followed by a partnership timing module, and behavioral inventory for each partner.

A brief description of the partnership timing module follows. Participants were provided a calendar grid that displayed the previous 6 months in columns, and partner nicknames on the rows and asked to indicate in which months they had sex with each partner (Figure 1). Two or more common months of sex between two partners classified the triad as concurrent. If the responses indicated a single overlapping month between two partners, and was thus ambiguously concurrent or serial, follow-up questions (Figure 1b) were asked to establish whether the participant was with the two partners serially or concurrently during the indicated month. This technique benefits from the easier recall afforded by month-level calendar and direct questioning approaches, but gains the exact sequencing information provided by measuring dates of sex [21]. The questionnaire was designed in SurveyGizmo 2.6 and hosted on www.surveygizmo.com.

Concurrency outcomes

Based on the calendar responses, measures of concurrency were calculated at the triadic and participant levels. For each triad, the duration of overlap in months was calculated (range: 1–6). Triads were considered concurrent if the months of sex with both partners overlapped by >= 2 months, if they overlapped by 1 month and one partner's interval entirely contained the 1 month relationship of the other partner, or based on responses to the clarification questions. Each concurrent and serially monogamous triad of partners was classified according to whether UAI occurred with both partners in the previous 6 months.

From the triadic data, we calculated at the participant-level: cumulative occurrence of concurrency and concurrent UAI in the previous 6 months, the number of concurrent triads, UAI triads, unique concurrent partners, and the total months of concurrent overlap ('concurrency-months').

Partners of all genders were counted in concurrency determinations (female and transgender partners represented < 3% of partnerships). Though we collected UAI for partners of all genders, we chose to only include male partnerships in our outcome of concurrent UAI.

Analysis

Participant-level demographics and concurrency outcomes were summarized descriptively, stratified by participant race/ethnicity, and compared using χ^2 and Kruskal-Wallis tests. The concurrency outcomes were summarized overall and for those who had concurrent partnerships. Categorical measures were compared across racial/ethnic groups using χ^2 tests and continuous ones using one-way ANOVA. Racial/ethnic group comparisons were done both overall and pair-wise, with white non-Hispanic MSM as the referent group.

Data were next examined at the triad level, using all possible pairs of partners reported by each participant with more than one partner (up to ${}_5C_2 = 10$ triads per participant). The association between a triad being concurrent and involving UAI with both partners was

calculated using odds-ratios (OR) and compared by race/ethnicity using the χ^2 and Breslow-Day tests. This was done both overall and for just triads in which anal intercourse occurred with both partners. We additionally adjusted our OR estimates for repeated measures on participants using a repeated measures GEE logistic regression model with an exchangeable ln(OR) correlation structure [23].

The post-processing of the response data and all analyses were conducted in SAS ver 9.2.

Results

A total of 6,104 men reporting a male sex partner in the previous 12 months began the online behavioral questionnaire. Among them, 4,138 (68%) remained in the questionnaire and answered questions about male sex within the previous 6 months, with 3,768 (91%) having a partner within the previous 6 months. Of these MSM, 3,471 (92%) completed the partnership timing module. The 2,940/3,471 (85%) MSM who self-reported white, black, or Hispanic race/ethnicity form the basis for this analysis.

The analytic sample was 63% white non-Hispanic, 21% black non-Hispanic, and 17% Hispanic. The overall median age of 27 years (IQR: 22 – 39, range: 18 – 79) and white participants were on average older than their black and Hispanic (median 29, 26, 25 years respectively, $p < .0001$). Nine percent of white, 18% of black, and 7% of Hispanic MSM self-reported being HIV-positive ($p < .0001$). White participants were more likely to hold a college degree compared to black and Hispanic participants (44% vs 34%, 33% respectively, $p < .0001$) and less likely to identify as bisexual (12% vs 30%, 19% respectively, $p < .0001$). These participants provided data on 8,911 partners. Seventy-three percent of participants (2,144/2,940) reported more than one sex partner in the previous 6 months, allowing for concurrency to be determined among 12,812 triads.

The participant-level concurrency findings are presented by race/ethnicity in Table 1. Among all participants, 45% of white, 45% of black, and 46% of Hispanic participants indicated at least one pair of concurrent partnerships (concurrent triad) in the previous 6 months ($p = 0.84$). No other concurrency metric was found to be racially differential at the participant unit of analysis (Table 1). Overall, 16% of participants indicated a concurrent UAI triad. The 1,326 MSM with at least one concurrent triad in the previous 6 months had a mean of 3.6 concurrent triads, involving a mean of 3.5 unique partners and 8.6 concurrency-months, while 39% engaged in UAI with both partners of a concurrent triad.

Table 2 displays findings at the triad level. Among the 12,812 triads involving participants with more than one partner, 38% were concurrent (rather than serially monogamous). These findings did not significantly vary by race/ethnicity (adjusted $p = 0.21$). The duration of concurrent overlap was significantly shorter for white MSM compared to black and Hispanic MSM (51% had ≤ 1 month overlap vs. 48% and 49%, respectively. Table-wide $p = .02$), but this modest difference is likely not practically important. UAI occurred with both partners among 31% of concurrent triads and was also not different by race/ethnicity (adjusted $p = 0.09$).

Additionally, there was a positive association between triadic concurrency and UAI: triads were more likely to involve UAI with both partners if they were concurrent (unadj. OR [95% CI] = 1.93 [1.75, 2.14], adj. OR = 1.57 [1.41 1.75]). This association was consistent across levels of by participant race/ethnicity (adjusted $p = 0.95$).

Individual and triadic level concurrency results are also provided stratified by categories of participant age in Supplementary Digital Content Tables 1 and 2.

Discussion

In this largest study of concurrency among MSM to date, the six-month period prevalence of concurrency was high, with the prevalence at least four times that reported among their heterosexual counterparts in a nationally representative survey and involving more partners[14], but consistent with the limited reports on MSM [15].

Although the level of condom use among concurrent MSM triads was similar to that reported for heterosexuals [20], the overall levels of concurrent unprotected sex were higher due to the greater prevalence of concurrency. MSM who had a concurrent partnership were also concurrent with more partners than are concurrent heterosexuals. Combining these concurrency findings with the greater per-episode transmission risk of UAI compared to unprotected vaginal intercourse [24], MSM may face a far higher transmission burden due to biologically relevant concurrency and concurrency may be an important factor in the disproportionately high incidence seen among MSM.

At the individual level, we observed comparable levels of concurrency and concurrent UAI across race/ethnic groups, furthering our existing understanding that MSM of color do not engage in riskier sexual behaviors with the knowledge that MSM of color also do not have riskier patterns of concurrency at this level. Nonetheless, the implications of this finding for explaining differential HIV incidence are not conclusive. Similar but high levels of concurrent UAI, in conjunction with racial/ethnic differences in HIV prevalence and potentially in assortativity and network size between the sexual networks of black, white, and Hispanic MSM may still help explain disparities in HIV transmission and highlight a significant role for concurrency. Further, although we describe the prevalence of individual patterns of engaging in concurrent sex, this cannot be directly related to individual HIV acquisition risk, because this risk is imparted onto one's partners, not oneself. Our data revealed substantial racial/ethnic mixing (partnership racial concordance of 66% for white, 65% for black, and 37% for Hispanic participants). To the extent that racial mixing is occurring, a participant's race/ethnicity is not a reliable marker of his partner's race/ethnicity and it is difficult to make conclusions about racial/ethnic differences in HIV risk. Further analyses are needed.

Among our sample, concurrent partners were more like likely to be ones with whom unprotected sex occurred, compared to serial partners. This association of two transmission risk factors is a newly documented compound risk that was enabled through the use of triad-level analyses and further characterization of the circumstances underlying concurrency is needed.

This work is strengthened by the use of an improved measurement technique that gathered precise partner sequence data and was enabled by the programming of advanced online tools. Many of the partnerships reported by participants were short-term, with half being onetime encounters. The use of the typical approaches that classify concurrency at the one-month level of detail would have led to substantial undercounting of concurrency, since many partnership overlaps involving one-time encounters would be counted as single-month overlaps and thus assumed to be serial. Furthermore, by quantifying concurrency at the level at which it occurs, that of triads, and at the level of biological relevance, concurrent UAI, we have been able provide a fuller picture of concurrency among this sample of MSM, by race/ethnicity.

We recognize that our findings may be affected by the selection biases inherent in online behavioral research, which take the form of sampling, click-through, and questionnaire dropout biases. While it is difficult to quantify how these potential biases may have skewed our results, compared to the first (2003–2005) and second (2008) MSM cycles of NHBS,

our data show comparable racial diversity as well as patterns of behavioral risk [25,26]. For example, the median number of casual sex partners in the previous 12 months in both NHBS cycles was 3, whereas our sample had a median of 4 partners, and participants in both studies had a median of 1 main sex partner. Though our data are not nationally representative, this comparability to NHBS and the large sample size, coupled with the demographic and geographic diversity of this study, provide for robust estimates of concurrency among MSM. It is still possible that MSM sampled online or using the venue-based time-space sampling methods of NHBS do not represent the true distribution of risk behaviors among the general population of MSM. If online respondents of all racial/ethnic groups are more likely to engage in high-risk sexual behaviors, comparisons of concurrency between these groups could be biased toward the null hypothesis of equality. Caution should thus be exercised with generalizing these results to the general US population of MSM.

A few decisions may have limited our measurement of concurrency. In allowing participants to provide data on only up to 5 most recent sex partners, other partners earlier in the interval may not have been reported. Also, by using a six month recall period for sexual timing, concurrencies involving intermittent partnerships in which sex occurs less than twice during the recall period are missed. Both of these limitations would lower estimates of concurrency and thus our findings may be conservative. Although the concurrent triads involving a serodiscordant partnership most directly impact HIV transmission, we chose to not consider participant-reported partner HIV serostatuses in our analyses. Other results from these data demonstrated only a moderate level of dyadic pre-sexual discussion of HIV status (50–70%) [27]. Considering the high proportion of HIV-infected MSM who are unaware that they are infected [2] and the potential for partners to misrepresent their statuses, these participant-reported data would be an unreliable marker for this purpose. Future studies should quantify the subset of concurrent UAI triads that could actually increase HIV propagation, by ascertaining the true infection statuses of both participants and partners.

We observed very high prevalences of engaging in concurrent sex and concurrent UAI in the previous six months among MSM, and these concurrencies may contribute to current high rates of HIV transmission among MSM. Although these prevalences were not different by participant race/ethnicity, further analyses need to be conducted to understand the risk conferred to sex partners of different race/ethnicities as a result of concurrency. Our findings of high levels of concurrency and an association between concurrency and UAI highlight the need for further research to both understand the factors associated with concurrency and the degree of transmission among MSM that is attributable to this phenomenon. If subsequent works demonstrate concurrency to be a significant contributor to HIV transmission and modifiable behavioral determinants are identified, then the development of concurrency-related prevention interventions may be highly impactful for MSM in the United States. Consideration should be given to the addition of brief concurrency assessments in healthcare provider settings, and to the incorporation of concurrency messaging into risk reduction counseling.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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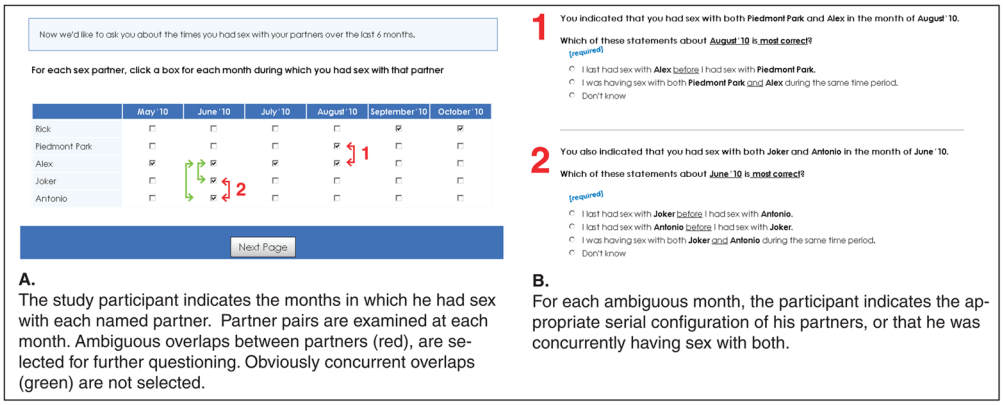

Figure 1.

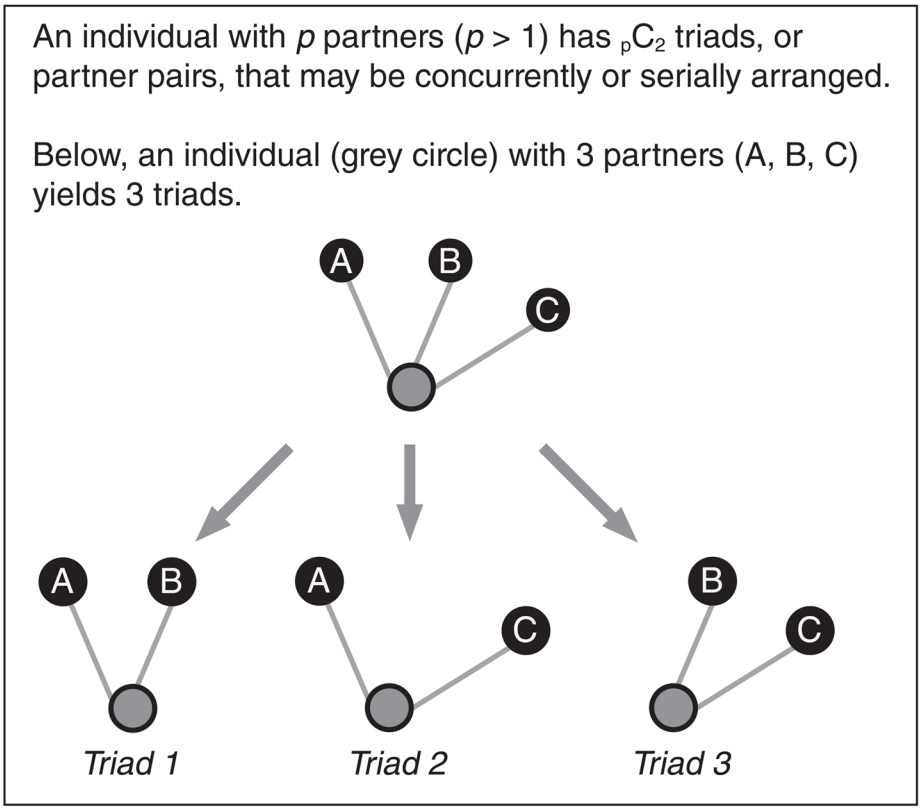

Figure 2.

TABLE 1

Participant-level concurrency and concurrent UAI in the previous 6 mo among 2,940 MSM, by participant race/ethnicity

	White, non- Hispanic *(n = 1,843)*	**Black, non- Hispanic *(n = 604)***	**Hispanic *(n = 493)***	***p***
	n (%)	***n (%)***	***n (%)***	
Overall				
Any concurrent triad [#]	829 (45.0)	269 (44.5)	228 (46.3)	0.84
Any concurrent UAI triad [*]	269/1,574 (17.1)	70/454 (15.4)	56/396 (14.1)	0.31
Mean number of concurrent UAI triads *(S.D., n)* [*]	0.42 (1.38, 1,574)	0.38 (1.21, 454)	0.28 (0.91, 442)	0.13 [a]
Participants with concurrent partnerships	*(n = 829)*	*(n = 269)*	*(n = 228)*	
Any concurrent UAI triad *(%)* [*]	269/663 (40.6)	70/190 (36.8)	56/164 (34.2)	0.26
Mean number of concurrent UAI triads *(S.D., n)* [*]	1.01 (1,98, 663)	0.92 (1.74, 190)	0.67 (1.33, 164)	0.11 [a]
Mean number of concurrent triads *(S.D.)*	3.70 (2.91)	3.57 (2.93)	3.53 (2.74)	0.67
Mean unique concurrent partners *(S.D.)*	3.49 (1.24)	3.38 (1.26)	3.42 (1.22)	0.44
Total concurrency-months *(S.D.)*	8.65 (12.06)	8.72 (12.51)	8.22 (8.22)	0.88

[#] Triads (partnership pairs) are comprised of a participant and two sex partners, and are the fundamental unit of concurrency

[*] Alternate sample sizes indicated where there are missing UAI response data

[a] White non-Hispanic vs. Hispanic, $P = 0.04$

TABLE 2

Triad-level concurrency and concurrent UAI in the previous 6 mo among 12,812 partner triads, involving 2,114 MSM participants with multiple partners in the previous 6 mo, by participant race/ethnicity[#]

	White, non-Hispanic *(n = 7,907)*	**Black, non-Hispanic *(n = 2,728)***	**Hispanic *(n = 2,177)***	***Unadj. P***	***Adj. P*[1]**
	n (%)	***n (%)***	***n (%)***		
Concurrent triad	3,064 (38.8)	960 (35.2)	805 (37.0)	0.0032	0.21
Duration of concurrent overlap (months)				0.02	--
≤1	1,557 (50.8)	458 (47.7)	398 (49.4)		
2	424 (13.8)	149 (15.5)	145 (18.0)		
3	376 (12.3)	108 (11.3)	85 (10.6)		
4	207 (6.8)	77 (8.0)	45 (5.6)		
5	195 (6.4)	54 (5.6)	40 (5.0)		
≥6	305 (10.0)	114 (11.9)	92 (11.4)		
UAI in previous 6 mo, overall				***P interaction***	
Among concurrent triads	667/2039 (32.7)	174/563 (30.9)	110/486 (22.6)	***Unadj.***	***Adj.*** [1]
Among non-concurrent triads	739/3,719 (19.9)	200/1,095 (18.3)	161/1,062 (15.2)		
Prevalence OR (95% CI):	*1.96 (1.73, 2.22)*	*2.00 (1.58, 2.53)*	*1.64 (1.25, 2.15)*	0.46	0.95
UAI in previous 6 mo, among AI triads					
Among concurrent triads	667/1,290 (51.7)	174/398 (43.7)	110/319 (34.5)		
Among non-concurrent triads	739/1,856 (39.8)	200/652 (30.7)	161/553 (29.1)		
Prevalence OR (95% CI):	*1.62 (1.40, 1.87)*	*1.76 (1.36, 2.27)*	*1.28 (0.95, 1.72)*	0.26	0.57

[#]Triads (partnership pairs) are comprised of a participant and two sex partners, and are the fundamental unit of concurrency

[1]Adjusted for repeated measures on respondents