Title: Predictors of concurrent heterosexual relationships among young males in the US

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Introduction

It has been suggested that three factors are important to determine individual's risk of acquiring human immunodeficiency virus (HIV) and other sexually transmitted infections (STI): the contact/exposure rate to new partners, the probability that a partner is infected, and the efficiency of transmission of infection from infected to non-infected partners.[1 2] Thus, research on STIs has focused on sexual networks and patterns of sexual relationships in hope to measure these parameters.

The HIV prevalence in the US was higher among men than women, and it has been consistently higher among non-Hispanic Black population compared to their counter populations at all ages in 2003.[3] The same trend in disparities among races was seen in STI prevalence in 2006.[4] Some studies suggested that differences in STI/HIV prevalence between non-Hispanic Black and White may be attributable to the difference in types and prevalence of sexual networks, specifically the prevalence of concurrent sexual relationships in these two race groups.[5 6]

Network theory argues that concurrent sexual relationships (multiple sexual relationships overlapping in time) are more efficient in transmitting an STI/HIV compared to same number of non-overlapping sexual relationships.[7 8] A mathematical model also showed that concurrent sexual relationships accelerated the spread of HIV, [9] and concurrent sexual relationship has emerged as an independent risk factor over and above the number of sex partners.[10 11] A recent population-based social network study using network analysis method reported that a position in a sexual network was strongly associated with an individual's STI risk when age, gender, condom use and survey variables were adjusted: being the center of non-dyadic network component, or being a

peripheral position of non-reciprocal dyad, even if having only one partner, increased the odds of being infected about 5-6 times greater than being in a reciprocally reported dyad.[12]

A cross-sectional study reported that concurrent relationships among males in reproductive ages (15-49) in the US were common (11%).[13] The study found that these men were more likely to report drug or alcohol use during sexual intercourse, perceive their female partners as not monogamous and have ever experienced sex with another male. These behaviors are known determinants to increase the risk of HIV and other STIs transmissions.[14 15]

The study reported here investigated behavioral as well as sociodemographic predictors of concurrent heterosexual relationships among males in the US, using the National Survey of Adolescent Males (NSAM) data. The NSAM cohort, a nationally representative cohort of adolescent males aged 15-19 in 1988, were followed up twice in 1991 and 1995. The study used the longitudinal cohort data in order to further the knowledge of correlates of males' concurrent relationships, which could vary over time.

The specific aims of the study were to describe the characteristics of those males who engaged in concurrent heterosexual relationships during the 12 months prior to each survey, to describe the patterns of concurrent heterosexual relationships over time, to investigate correlates of concurrent heterosexual relationships of NSAM males at each survey respectively, and to identify the predictors of concurrent heterosexual relationship among young males in the US.

Methods

The study used data from three surveys of NSAM cohort ($N_{Baseline}$=1880) who were15-19 years in 1988 until 1995 when these male respondents were 21-26 years old. Sociodemographic and behavioral characteristics of NSAM males who participated all surveys (N_{ALL}=1290) were reported. The study first examined concurrent heterosexual relationships among young males in series of cross-sectional analyses. The outcome of the analyses was engaging in concurrent heterosexual relationship during the 12 months prior to each survey (1: had overlapped heterosexual relationships in the past 12 months, 0: did not in the past 12 months). The study described the patterns of reported concurrent relationship status over three surveys.

The study then examined the correlates of concurrent heterosexual relationships using NSAM respondents who had been sexually experienced at each survey among those who participated in all three surveys (N_{ALL}=1290). The study repeated the analysis using respondents participating at each survey (N_{1988}=1880, N_{1991}=1676, and N_{1995}=1377), respectively. Series of cross-sectional analyses using two different denominators were conducted to understand if respondents' self-selection into adhering to the NSAM survey over time modifies the association between important correlates and concurrent heterosexual relationship status.

Bivariate logistic regression analyses assessed behavioral correlates of concurrent relationships in the past 12 months in addition to respondents' sociodemographic characteristics. Selected correlates included respondents' age, respondents' self-reported race (categorical: non- Hispanic Black, non- Hispanic White, Hispanic, Others), living environment at age 14 (categorical: 2-biological parents, 1-biological parent, 1-step parent, neither), mothers' highest education (categorical: less than high school, high school grad/some college, college graduate or over), respondents age at first sex, reported educational attainments by each survey (continuous: years), ever married by '95 survey (binary: 1: ever, 0: never), reported number of lifetime sex partner by each survey (continuous), reported number of sex partner during the 12 months prior to each survey (continuous), ever had one-time sex partner by each survey (binary: 1: ever, 0:never), ever had prostitute by each survey (binary: 1: ever, 0: never), ever had male partner by each survey (binary: 1: ever, 0: never), and % condom use with all sex acts in the past 12 months.

Multivariate logistic regression analyses were conducted for each survey. It was reasonable to assume that concurrent relationship status at previous survey was correlated with the status at current survey. Thus, multivariate logistic regression models for current surveys included the report of concurrent relationship at previous survey (i.e. including concurrent relationship status reported at '88 [at '91] survey as one of correlates for the '91 [or '95] model). The final model included race, highest grade at survey (quartile), living environment at age 14, mother's education, reported concurrent relationship at the previous survey (for '91 and '95 surveys), years sexually active (derived from respondents' age and age at first sex), # of partner in the past 12 months at

the survey (quartile), ever had sex w/prostitute by survey X, ever had one time partner by survey X.

The study conducted several sensitivity analyses, including alternative outcome of ever had concurrent relationship by each survey (i.e. 1: once respondents reported having a concurrent relationship, 0: respondents reported never having concurrent relationship over three surveys), quartile of respondents' highest educational attainment, quartile of number of lifetime sex partners, quartile of sex partner during the past 12 months prior to the survey, quartile of % condom use with all sex acts in the past 12 months. All statistical analyses were conducted using STATA SE 10.0 (Stata Corporation, College Station, Texas)

Results

Sociodemographic and behavioral characteristics of NSAM respondents, who participated in three surveys (N_{ALL} =1290), were described by sexual debut status in Table 1. The percent of sexually experienced adolescent male respondents aged 15-19 in 1988 continued increasing over time from 65% in 1988, 86% in 1991, and reached 95% in 1995, when they became 21-26 years old. Older age at the time of survey and higher education were associated with being sexually experienced at the time each survey was conducted, although respondent age at the survey was no longer relevant to the status of being sexually experienced at the 1995 survey. There seemed to be difference in status of being sexually experienced at each survey by race, living environment at age 14, and mother's highest education.

Table 2 described sociodemographic and behavioral characteristics of those who reported concurrent relationship among those who had ever had sex at each survey. Older age was related to having concurrent relationships at the survey only in 1988. Respondents' educational achievement in years showed equivocal results over time. Early age at first sex, greater number of lifetime sex partner at each survey, and greater number of sex partner in last 12 months was consistently associated with the status of concurrent relationship at each survey. Respondents' race and living environment at age 14 showed significant association with having concurrent relationships at each survey. Respondents who reported concurrent relationships at each survey were more likely to

report ever had STIs and ever had sex with prostitute on the survey. Mother's highest education was not associated with the status of concurrent relationship at each survey.

The pattern of reported concurrent relationship status from over time was shown in Table 3. The most frequently observed patterns were [000] in which respondents never reported engaging in concurrent sexual relationship in the 12 months prior to any survey. The result was consistent for a total survey sample ($N_{Baseline}$=1880) and also sub-sample of those who participated in three surveys (N_{ALL} =1290). Another common pattern was [010] in which some respondents, who did not report concurrent sexual relationship at the first survey and reported one at the 1990 survey, did not report concurrent relationship at the 1995 survey. Those who had repeatedly reported concurrent relationship in two later surveys ([011]:104) and those who reported concurrent relationship at all surveys ([111]: 51) were identical in a baseline cohort and respondents who participated in all surveys.

Bivariate logistic regression analysis identified years being sexually active, number of lifetime partner at each survey, number of partner during 12 months prior to each survey, being Black, being White, lived with 2 biological parents at age 14, ever had one-time partner by each survey, and ever had sex with prostitute at each survey as important sociodemographic and behavioral correlates of concurrent heterosexual relationships reported at each survey (Table 4). These associations were shown in expected directions: the odds of having concurrent heterosexual relationship at each survey were lower when respondents were White, had lived with 2 biological parents at age 14, and had initiated sexual intercourse at older age. The odds were higher when respondents were Black, had greater number of sex partners at the time of the survey, had ever had one-time partner, and had ever had sex with prostitute. Ever had sexual act with other male was not associated with concurrent relationship history.

Multivariate analyses showed a consistent trend that number of sex partner during the past 12 months at each survey was a single variable that had significant positive association with concurrent relationship status at each survey when other covariates were in the model. The concurrent relationship status reported on the previous survey also showed strong association with the current concurrent relationship status. The association between concurrent relationship status and number of sex partner during the

past 12 months at each survey persisted over time (Table 5-1 and 5-2). The effect size of number of sex partners during the past 12 months increased monotonically in the later two surveys in which the multivariate model included concurrent relationship status at previous surveys. The result from a series of cross-sectional analyses confirmed that respondents who adhered to all surveys were not different from those who censored over time. Respondents' sociodemographic characteristics (Black) showed positive associations with concurrent relationships status at later surveys.

Discussions

The study examined the correlates of concurrent relationships among young US males using a longitudinally collected nationally representative cohort. Multivariate logistic regression analysis results suggested that concurrent relationships at an earlier stage of males' life could be explained by sexual risk behaviors and sociodemographic characteristics (race) emerged as important factors as they age. Number of sex partners during the 12 months prior to each survey was a single strong predictor even when the concurrent relationship status reported in the previous survey was taken into account.

Although adolescents who did not have two biological parents have seemed more likely to report concurrent relationships at later surveys in bivariate analysis, the association was not persistent when other factors were in the model. Disadvantaged life experience in childhood, specifically having one biological parent lived with someone who was not the other biological parent, could emerge in their norm in socialization in their later adult life. The sample sizes of those who did not have two biological parents, however, were small, the results were equivocal.

The study did not find sex with other male or % condom use as important correlates. NSAM cohort included a very small number of males who had sex with males, and this could limit the ability to examine the association with concurrent relationship status and MSM. The total % condom used in all sex acts in the 12 months was compared in ever reporting concurrent relationship vs. never, assuming equal probability of condom use at each sex act for both group. This could be a false assumption as condom use varies depending on partner types and frequency of sex. A recent study[16] applying cluster analysis method to NSAM cohort showed that those who had risky sexual behaviors were not always in a highly protected (by consistently using

condom) group, and this could be a potential explanation that total % condom use did not show the association with the reported concurrent relationship status.

The study was unique as the use of longitudinal nature of NSAM data allowed us to separate the cohort-effect from the age-effect, which other studies using cross-sectional survey, such as NSFG, could not. The study was also able to look at respondents' selection into adhering to NSAM survey and the attrition issues. The results were robust, thus the study suggest the respondents who participated all surveys were not different from those who concerned over time. The study, however, only had the ability to examine the concurrent relationship status during the 12 months period prior to each survey, and assumed respondents behaviors and concurrent relationship status were the same during the period when the survey did not collect data. Males' risk behaviors at each sex act may not be stable as they age during late adolescents through twenties. The three surveys were conducted in 1988 when the respondents were aged 15-19, 1991, and 1995; thus the study could only extrapolate the results during the 12 months prior to each survey.

Conclusions

The study concluded predictors of concurrent heterosexual relationships among young males of US by using longitudinally conducted surveys: number of sex partners during the 12 months prior to each survey and concurrent relationship status reported at the previous survey. The study suggested STI prevention at male's early life should focus on minimizing the number of sex partners. Later prevention plans should include components that are culturally appropriate.

Table 1: Description of NSAM respondents [a)] who participated all surveys (n=1290) by sexual debut status (weighted)

Survey		'88				'90				'95			
		ALL	ever had sex	never had sex		ALL	ever had sex	never had sex		ALL	ever had sex	never had sex	
	n	1290	**838**	450		1290	**1109**	181		1290	**1228**	62	
	(%)	(100%)	**(65%)**	(35%)		(100%)	**(86%)**	(14%)		(100%)	**(95%)**	(5%)	
			mean				**mean**				**mean**		
R's age at survey		17.42	17.84	16.83	*	20.42	20.54	19.84	*	24.42	24.43	24.23	
R's grade at survey		10.48	10.88	9.92	*	12.25	12.75	12.14	**	14.11	14.06	14.95	†
			%				**%**				**%**		
R's Race	Black	14.51	19.86	6.98	*		16.14	6.66	*		14.88	8.44	*
	White	73.15	68.47	79.78	*		71.92	79.1	*		72.88	77.57	†
	Hispanic	9.32	8.8	10	*		8.99	10.91	**		9.16	11.88	
	Others	3.02	2.87	3.23	**		2.96	3.33			3.08	2.1	†
living env@14	2 bio	70.81	66.9	76.27	*		68.87	80.16	*		70.22	80.49	**
	1bio	18.2	21.61	13.43	*		19.52	11.83	*		18.52	12.96	**
	1step	9.29	8.9	9.82			9.65	7.51			9.52	5.48	
	neither	1.46	2.17	0.47	†		1.66	0.51			1.49	1.07	
Mom's education	<HS	13.39	14.52	11.81			14.82	6.47			13.51	11	
	=HS or Col	55.74	58.02	52.59	†		56.31	52.96	†		56.26	47.2	
	>BA/BS	30.88	27.46	35.6			28.87	40.57	**		30.21	41.81	†

*: p<0.001, **: p<0.05, †:p<0.1

a): Cohort of males who were 15-19 years old in 1988

Table 2 : Description of NSAM respondents [a)] of those who had ever had sex by sexual concurrency status (weighted)

Survey		'88	Concurrent Relationship		'90	Concurrent relationship		'95	Concurrent Relationship	
			Yes	No		Yes	No		Yes	No
	n	**838**	**190**	648	**1109**	**449**	660	**1228**	**569**	659
	(%)	**(100%)**	**(22.7%)**	(77.3%)	**(100%)**	**(40.5%)**	(59.5%)	**(100%)**	**(46.3%)**	(53.7%)
			mean			**mean**			**mean**	
R's age at survey			18.03	17.8 **		20.57	20.53		24.39	24.46
R's grade at survey			11.09	10.83 †		12.18	12.32		13.62	14.33 **
R's age first sex			13.61	14.79 *		14.31	15.66 *		14.54	16.51 *
# of partner ever at survey			32.95	16.59 *		27.94	11.81 *		26.87	8.96 *
# of partner past 12 months			4.38	1.5 *		4.13	1.44 *		3.22	1.2 *
total % condom used in the past 12 mo			38.4	37.3		37.1	39.7		40	39.9
			%			**%**			**%**	
R's Race	Black		30.68	17.42 **		25.69	11.46 *		23.26	9.39 *
	White		58.6	70.69 †		64.6	75.51 *		66.58	76.8 *
	Hispanic		6.52	9.31 **		7.41	9.76 **		8.17	9.72 **
	Others		4.2	2.57		2.3	3.28		1.98	4.09 †
living env@14	2 bio		55.16	69.53 **		57.95	74.23 *		60.28	76.16 *
	1bio		26.86	20.43		24.24	17.2 **		22.73	15.34 **
	1step		9.07	8.87		13.77	7.63 **		13.58	7.59 *
	neither		6.63	1.17		3.14	0.94		2.66	0.91
Ever had one time partner			4.32	2.36 *		9.77	2.54 *		11.33	3.7 *
Ever married by '95			33.05	37.7		32.36	32.11		25.07	32.62 **
Ever had sex with prostitute			20.23	6.89 **		14.72	5 **		12.18	4.27 **
Ever MSM at '95			6.09	1.86 **		4.23	3.69		4.75	3.08 *
Mom's education	<HS		19.53	13.39		15.48	14.5		14.42	12.76
	=HS or Col		53.73	58.98		56.38	56.28		55.32	55.95
	>BA/BS		26.73	27.63		28.13	29.23		30.27	31.3

*: p<0.001, **: p<0.05, †:p<0.1 a): Cohort of males who were 15-19 years old in 1988

Table 3. Patterns of concurrent relationship status

Patterns over three surveys			Baseline ('88) cohort (N=1880)		Rs who participated all surveys (N=1290)	
			Frequency	%	Frequency	%
0	0	0	1096	58.3	721	55.89
0	0	1	140	7.45	120	9.30
0	1	0	248	13.19	155	12.02
0	1	1	104	5.53	104	8.06
1	0	0	117	6.22	62	4.81
1	0	1	21	1.12	17	1.32
1	1	0	103	5.48	60	4.65
1	1	1	51	2.71	51	3.95
Total			1880	100.00	1290	100.00

1: had concurrent relationship in the past 12 months, 0: did not have concurrent relationship in the past 12 months

Table 4. Bivariate logistic regression
Covariates for concurrent relationship in the past 12 months (n= ever had sex) among respondents participated all surveys (N=1290)

Survey		88				90				95			
Ever had sex by survey X (%)		838 (65.0)				1109 (86.0)				1228 (95.2)			
		OddsRatio	(	95%CI	)	OddsRatio	(	95%CI	)	OddsRatio	(	95%CI	)
R's age at survey		1.15	(	0.94.1.39	)	1.02	(	0.89,1.17	)	0.97	(	0.86,1.10	)
R's grade at survey (quartile)		1.16	(	0.99.1.37	) †	1.03	(	0.93,1.15	)	0.93	(	0.77,1.12	)
Years sexually active [b)]		1.30	(	1.20,1.40	) *	1.17	(	1.12,1.23	) *	1.10	(	1.06,1.15	) *
# of partner ever at survey (quartile)		4.25	(	3.34,5.39	) *	1.87	(	1.61,2.16	) *	2.46	(	2.11,2.87	) *
# of partner past 12 months (quartile)		6.89	(	5.11,9.28	) *	10.05	(	7.71,13.1	) *	348	(	110,1097	) *
total % condom used in the past 12 months (quartile)		1.03	(	0.87,1.26	)	0.96	(	0.82,1.12	)	1.13	(	0.96,1.32	)
R's Race	Black	2.10	(	1.34,3.29	) *	2.67	(	1.91,3.73	)	3.03	(	2.16,4.25	) *
	White	0.60	(	0.36,0.96	) **	0.59	(	0.42,0.84	)	0.58	(	0.42,0.81	) *
	Hispanic	0.68	(	0.37,1.24	)	0.74	(	0.43,1.28	)	0.83	(	0.50,1.36	)
	Other	1.66	(	0.35,7.87	)	0.69	(	0.21,2.25	)	0.47	(	0.16,1.40	)
living env@14	2 bio	0.54	(	0.31,0.93	) **	0.48	(	0.32,0.72	)	0.50	(	0.34,0.73	) *
	1bio	1.43	(	0.81,2.54	)	1.54	(	0.99,2.40	)	1.61	(	1.05,2.46	) **
	1step	1.02	(	0.37,2.88	)	1.93	(	0.99,3.77	)	1.76	(	0.94,3.28	) †
	neither	6.00	(	0.99,18.1	) *	3.42	(	1.31,8.95	)	2.94	(	1.16,7.49	) **
ever had STD at survey		1.87	(	0.77,4.56	)	4.16	(	1.97,8.80	) *	3.33	(	1.84,6.02	) *
ever had sex with prostitute		0.90	(	0.20,4.14	)	2.47	(	0.99,6.14	)	4.02	(	2.03,7.95	) *
ever MSM at survey		0.63	(	0.10,3.86	)	0.52	(	0.17,1.57	)	1.54	(	0.53,4.49	)

*: p<0.001, **: p<0.05, †:p<0.1 b): Years sexually active = (age at first sex) – (age at survey X)

Table 5-1. Multivariate logistic regression
Concurrent relationship in the past 12 months and selected covariates (among those who ever had sex) among respondents who participated all surveys (N=1290)

Survey X		88			91			95		
Ever had sex by survey X (%)		838 (65.0)			1109 (86.0)			1228 (95.2)		
		Odds Ratio (n=736)	(95%CI)		Odds Ratio (n=886)	(95%CI)		Odds Ratio (n=1194)	(95%CI)	
Reported concurrent relationship at the previous survey		NA	NA		2.41	(1.53,3.81)	*	2.16	(1.45,3.21)	*
Years sexually active		1.11	(1.00,1.22)	**	1.09	(1.01,1.17)	**	1.00	(0.92,1.08)	
R's grade at survey (quartile)		1.16	(0.93,1.43)		1.11	(0.96,1.29)		0.87	(0.65,1.17)	
# of partner in the past 12 months at survey X (quartile)		7.26	(5.24,10.1)	*	10.1	(7.64,13.3)	*	308	(97.1,978)	*
Ever had one time partner by survey X		0.83	(0.67,1.04)		0.96	(0.77,1.21)		1.13	(0.94,1.35)	
Ever had sex w/prostitute by survey X		1.31	(0.25,7.06)		0.88	(0.39,2.00)		1.50	(0.92,2.43)	
R's Race	Black	1.13	(0.69,1.84)		1.72	(1.13,2.62)	**	2.02	(1.47,2.79)	*
	White	1.00	reference		1.00	reference		1.00	reference	
	Hispanic	0.89	(0.46,1.71)		1.23	(0.74,2.06)		1.20	(0.84,1.72)	
	Other	2.41	(0.53,11.1)		1.24	(0.39,3.90)		0.93	(0.40,2.17)	
living env@14	2 bio	1.00	reference		1.00	reference		1.00	reference	
	1bio	0.92	(0.57,1.49)		1.03	(0.68,1.56)		1.34	(0.84,2.16)	
	1step	0.96	(0.46,2.00)		1.89	(1.05,3.40)	**	1.40	(0.75,2.62)	
	neither	2.14	(0.73,6.30)		0.48	(0.17,1.41)		0.41	(0.14,1.19)	†

Final model included Race, Highest grade at survey (quartile), Living environment at age 14, Mother's education, Reported concurrent relationship at the previous survey (for '91 and '95 surveys), Years sexually active, # of partner in the past 12 months at the survey (quartile), Ever had sex w/prostitute by survey X, Ever had one time partner by survey X.

*: $p<0.001$, **: $p<0.05$, †:$p<0.1$

Table 5-2. Multivariate logistic regression
Concurrent relationship in the past 12 months and selected covariates (among those who ever had sex) among those who participated at each survey

Survey X (N)		88 (N=1880)		91 (N=1676)		95 (N=1377)	
Ever had sex by survey X (%)		1263 (67.2)		1465(87.4)		1314 (95.4)	
		OddsRatio (n=1125)	95%CI	Odds Ratio (n=1423)	95%CI	Odds Ratio (n=1290)	95%CI
Reported concurrent relationship at the previous survey		NA	NA	2.34	(1.59,3.45)*	1.97	(1.34,2.91)*
Years sexually active		1.11	(1.02,1.20)**	1.07	(1.01,1.14) **	1.00	(0.92,1.07)
R's grade at survey(quartile)		1.26	(1.04,1.47)**	1.10	(0.97,1.25)	0.92	(0.70,1.23)
# of partner in the past 12 months at survey X (quartile)		6.91	(5.32,8.99)*	9.72	(7.70,12.3) *	255	(93.5,698)*
Ever had one time partner by survey X		0.84	(0.71,1.01)	1.06	(0.88,1.29)	0.86	(0.68,1.08)
Ever had sex w/prostitute by survey X		1.56	(0.52,4.73)	1.40	(0.70,2.78)	1.47	(0.86,2.50)
R's Race	Black	1.23	(0.83,1.82)	1.41	(1.00,2.02)**	1.68	(0.10,2.66)**
	White	1.00		1.00		1.00	
	Hispanic	0.83	(0.49,1.39)	1.08	(0.69,1.68)	1.06	(0.63,1.81)
	Other	1.22	(0.38,3.85)	0.96	(0.38,2.46)	1.77	(0.45,7.00)
living env@14	2 bio	1.00		1.00		1.00	
	1bio	0.84	(0.56,1.24)	1.03	(0.72,1.47)	1.30	(0.82,2.05)
	1step	0.62	(0.34,1.09) †	1.32	(0.80,2.18)	1.50	(0.82,2.75)
	neither	1.35	(0.62,2.95)	0.62	(0.28,1.38)	0.41	(0.14,1.18)†

Final model included Race, Highest grade at survey (quartile), Living environment at age 14, Mother's education, Reported concurrent relationship at the previous survey (for '91 and '95 surveys), Years sexually active, # of partner in the past 12 months at the survey (quartile), Ever had sex w/prostitute by survey X, Ever had one time partner by survey X.

*: p<0.001, **: p<0.05, †:p<0.1

Reference

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