TITLE: The role of relationship types on condom use among high-risk urban men with concurrent partners in Ghana and Tanzania

AUTHORS:
Paul J. Fleming
Social and Behavioral Health Sciences, FHI360, Durham, NC USA
Health Behavior, University of North Carolina, Chapel Hill, NC USA
302 Rosenau Hall
Chapel Hill, NC 27599-7440
(tel) 630-777-0160
(fax) 919-966-2921
pfleming@unc.edu

Marta Mulawa
Health Behavior, University of North Carolina, Chapel Hill, NC USA

Holly Burke
Social and Behavioral Health Sciences, FHI360, Durham, NC USA

Dominick Shattuck
Social and Behavioral Health Sciences, FHI360, Durham, NC USA

Greg Guest
Economic Development & Livelihoods, FHI360, Durham, NC USA

ABSTRACT

Multiple concurrent partnerships are hypothesized to be important drivers of HIV transmission. Despite the demonstrated importance of relationship type (i.e. wife, girlfriend, casual partner, sex worker) on condom use, research on concurrency has not examined how different combinations of relationship types might affect condom use. We address this gap, using survey data from a sample of men from Ghana (n=807) and Tanzania (n=800) who have at least three sexual partners in the past three months. We found that approximately two-thirds of men's reported relationships were classified as a girlfriend. Men's condom use with girlfriends was associated with his other relationship types. Men were more likely to use a condom with a girlfriend if their other partner was a wife compared to if their other partner was a sex worker (Ghana OR 3.10, 95% CI, 1.40, 6.86; Tanzania OR 2.34 95% CI 1.35, 4.06). These findings stress the importance of relationship type when examining concurrency.

INTRODUCTION

Concurrent, or overlapping, sexual relationships have been hypothesized as an important driver of HIV transmission(1-3). It is believed that concurrent sexual relationships facilitate the rapid spread of HIV through a sexual network during acute infectious stage (4, 5). While the role of concurrent partnerships in the HIV epidemic has been hotly debated over the past decade (6-9), current evidence and discussion typically fails to account for nuances in different partner types within concurrent relationships.

Most prior research treats all individuals engaging in concurrent partnerships equally. The UNAIDS consensus for how to measure concurrency does not make any distinctions based on combinations of relationship type (10). In the major published studies examining the role of concurrent partnerships, concurrency is measured as a dichotomous indicator variable with those reporting 2 or more concurrent relationships being classified as having concurrent sexual partnerships (7, 11, 12). A recent review of measuring concurrent partnerships did not focus on assessing characteristics or type of relationships that are overlapping/concurrent, nor an individual's combinations of relationships type (13). Concurrency is officially defined by UNAIDS as, “overlapping sexual partnerships in which sexual intercourse with one partner occurs between two acts of intercourse with another partner” (p. 621) (10). With this definition, relationship types are ignored.

While existing research on concurrency does not take into account relationship characteristics, the evidence is strong that levels of intimacy, love and trust within

relationships influence HIV-risk behaviors including condom use. Likewise, relationship type is an important determinant (14). Condom use is generally least likely between spouses and most likely between sex workers and their clients. There is limited evidence on whether these trends are the same for those individuals with concurrent partnerships. One study with men in Kenya found that men with concurrent partnerships used condoms most frequently with sex workers, and more frequently with girlfriends when compared to wives (14), suggesting a similar trend as documented in previous studies of men that did not focus on concurrency.

The existing research on concurrency also fails to examine how condom use with one partner may be influenced by the relationship types of the man's *other* co-occurring relationships. The effect of concurrency on HIV risk depends on the assumption of unprotected sex with each of the overlapping partners. Despite the influence of relationship type on condom use, and the possibility that the characteristics of the overlapping relationships may influence condom use, no studies to date have examined variation in condom use and sexual risk for individuals with different combinations of concurrent relationship types. The current study proposes to fill this gap.

In this study, we analyze data collected from men with at least three concurrent sexual partnerships in Tema, Ghana and Mbeya, Tanzania to explore the dynamics between relationship types and condom use for men with concurrent partnerships. The aims of this analysis were to a) describe the prevalence of

each relationship type and rates of condom use with these sexual partners, b) examine the most common relationship type combinations among the men and assess associations between men's relationship type combination and their demographic characteristics, and c) explore the extent to which condom use is associated with relationship type combination.

METHODS

Data were collected from men in both sites aged 18-49 who had at least three different sex partners in the past three months. Data collection activities occurred from June to November 2008 in Tema, Ghana and September 2008 to February 2009 in Mbeya Region, Tanzania.

To ensure that we sampled from the regions at greatest risk for HIV, we carried out the research in two urban sites with high HIV prevalence relative to other areas of the respective countries. In Ghana, we selected Tema, the country's main seaport and industrial center, with a population of approximately 200,000. Tema is home to a large number of men engaged in factory work and long distance transport. According to the Behavioral Surveillance Survey (2003), Tema had one of the highest HIV prevalence rates in the country (6.4%), double that of the national rate (3.1%)(15). Mbeya is one of Tanzania's major trucking hubs, sitting at the crossroads of two major highways that connect six sub-Saharan countries. The city of 260,000 provides services for the region's workers and long distance truckers, and is home to numerous bars and other

places where sexual encounters are initiated. Mbeya has one of the highest HIV prevalence in Tanzania (9.2%), almost double the national average of 5.8%(16).

Time-space sampling was used to enroll a random probability sample of high-risk sexually-active men in both sites. High risk transmission areas (HTA) where such men congregate were identified, listed and confirmed in both cities through a combination of existing research data, local community outreach activities and observational research. Within each HTA, we generated an exhaustive list of venues where men presumed to be at high risk for HIV could be found in substantial numbers. A final set of 18 high-risk venues in Tema and 13 venues in Mbeya were selected for sampling.

Men who met the eligibility requirements of having at least three sexual partners within the past three months were interviewed by a male interviewer in a nearby private location after they gave their informed consent. In total, face-to-face interviews were conducted with 800 men in Tema and 807 men in Mbeya. This study was reviewed and approved by FHI360's Protection of Human Subjects Committee, the Ghana Health Service Ethical Review Committee, the Muhimbili University of Health and Allied Sciences Senate Research and Publications Committee, the Tanzania National Institute for Medical Research, and the Mbeya Medical Research and Ethics Committee.

Measures

Condom use at last sex

Our main outcome was self-reported condom use at last sex for each of the three reported relationships. Condom use at last sex for each relationship was measured dichotomously by asking each man whether or not a condom was used the last time he had vaginal sex with each partner.

Relationship type and combination

Each man was asked to categorize the relationship type for each relationship he reported by answering "What was your relationship to [woman] with whom you had sex?" Response options were, 'wife', 'girlfriend', 'casual acquaintance', or 'sex worker'. If they responded 'girlfriend', they were asked whether or not they were 'living together as if married'. For our analyses, we used this question to categorize each relationship into one of five types: wife, live-in girlfriend, non-live in girlfriend, casual acquaintance, and sex worker. Relationship combination was a categorical variable we created that was determined from the relationship type of each of the three women the man reported. In this paper, we will refer to non-live-in girlfriends as simply 'girlfriends' or 'GF'. If it is a live-in girlfriend, we will specify it as such or as 'live in GF'. In this paper we conceptualize the five relationship types on a scale of casualness with wives being the least casual, then live in GF, followed by non-live in GF, then casual acquaintance, and sex worker being the most casual relationship type.

Men's characteristics

We examined men's demographic characteristics (age, salary in the past month, and education), attitudes towards gender equality, and self-reported sexually transmitted infections (STI). Attitudes towards gender equality was measured using the Gender Equitable Men (GEM) Scale. Previous factor analysis with this data identified the variables most relevant for this population. For this analysis, we used men's factor scores from the modified GEM Scale (Shattuck et al. in press). Self-reported STI was assessed for each participant by asking each man the question “During the last 12 months, have you had a disease which you got through sexual contact?”

Analysis

Descriptive statistics were calculated to report means and prevalence of key variables for the study population. We conducted bivariate analyses to compare the men's characteristics with their relationship type combinations. Because of the large number of unique combinations, we conducted chi-squared tests for difference for each characteristic comparing (1st) all combinations, (2nd) the top 10 most prevalent relationship combinations, and then (3rd) the five combinations that had at least 2 girlfriends (there is substantial overlap between this category and the top five most prevalent; rationale for this criteria is explained in the results section). P-values were not adjusted for multiple testing.

For our third aim, we conducted logistic regression to assess differences between relationship type combinations and condom use at last sex with a selected sub-sample of partners with sufficient data to allow for meaningful analysis (to be further described in the results section). We report the unadjusted odds ratios and also conducted the same analysis with age, education, and salary in the model to produce adjusted odds ratios for condom use. Due to the sampling strategy, we accounted for clustering at the venue level and at the individual level by obtaining Huber-White corrected standard errors to account for the interdependence of men who socialize in the same venues as well as the multiple relationships reported by each man. All analyses were conducted using SAS version 9.3.

[TABLE 1. HERE]

RESULTS

Data were collected from 800 men in Ghana and 807 men in Tanzania (Table 1). Demographic data are summarized in Table 1. The mean age of the men in Ghana was 28 years and 30 years in Tanzania. Seventy-seven percent of the respondents in Ghana and 60% of those in Tanzania were single. The average income per month was $133 in Ghana and $171 in Tanzania. Six percent of respondents in Ghana and 27% in Tanzania had primary school or less education.

There were a total of 2367 relationships reported with complete data in Ghana, and 2392 in Tanzania. The majority of reported relationships in both locales were categorized as a non-live in girlfriend (GH: 67.9%; TZ: 65.3%), referred to as a 'girlfriend' or 'GF' in the rest of the paper. The next most prevalent relationship type was casual acquaintance (GH 15.8%; TZ 14.3%) and sex worker (GH: 8.0%; TZ: 8.1%). Sexual partners were less commonly described as a wife (GH: 4.0%; TZ: 8.1%) or a live-in girlfriend (GH: 4.4%; TZ: 4.2%).

For condom use, as the reported relationship type gets progressively more casual (wife is least casual, sex worker is most casual), reported condom use at last sex increased (Table 2.). The percentage of relationships in Ghana where the man reported condom use at last sex ranged from 13.8% with wives to 82.0% with sex workers. In Tanzania, men reported condom use during last sex with 8.8% of wives and 76.8% of sex workers. Men were also more likely to report condom use with a girlfriend than in relationships with wives (Ghana: 63.3%, OR 10.7, 95%CI= 5.9, 19.5; Tanzania: 69.3%, OR 23.5, 95%CI=13.5, 41.0).
[Table 2 here]

Relationship type combination and men's characteristics

The second aim of this study was to examine the association between relationship type combinations and men's characteristics (Table 3. and 4.). In total, there were 34 relationship type combinations for Ghanaian men, and 32

relationship type combinations for Tanzanian men (out of 35 total possible combinations). For brevity, in Tables 3 and 4, we display only the top 10 combinations for each location (the top 10 combinations account for 711 men (88.9%) in Ghana and 694 men (86.0%) in Tanzania). The most common relationship type combination in both sites was to have 3 girlfriends (GH: 37.5% of men; TZ: 34.8%). Other common combinations in both sites included having 2 girlfriends and 1 wife (GH: 7.5% of all men; TZ: 11.5%), 2 girlfriends and 1 live-in girlfriend (GH: 6.9%; TZ: 7.4%), 2 girlfriends and 1 casual acquaintance (GH: 15.1%; TZ: 9.3%), or 2 girlfriends and 1 sex worker (GH: 4.6%; TZ: 8.5%). In Ghana, one girlfriend and 2 casual acquaintances was also one of the most frequently reported (8.3%) but was less common in Tanzania (3.8%). All other relationship type combinations had less than 5% of men, with most combinations only having one or two men.

In both countries we examined whether men's relationship combinations were significantly associated with men's characteristics (age, salary, education level, GEM factor score, and self-reported STI). In Tanzania, we found a significant association ($p<.0001$) between men's relationship type combination and men's characteristics when conducting the analysis with three different samples: (1) all men, (2) men with one of the top ten most prevalent combinations, and (3) men with at least two girlfriends. In Ghana, only age, education, and GEM factor score were significantly associated ($p<.0001$) with relationship type combination for each of the three analyses. Self-reported STI in Ghana was only significantly

associated with relationship combinations for the analysis including all men ($p<.0001$) and the analysis of men with one of the top 10 combinations ($p=.0001$), but not for the analysis of men with at least two girlfriends ($p=.15$).

Examining the descriptive results qualitatively identifies some interesting differences between men with different relationship combinations. For example, in the Ghana sample, men with 2 girlfriends and 1 wife were on average 34.4 years old and 11.7% reported an STI, whereas men with 2 girlfriends and 1 casual partner were younger on average (26.6 years old) and a higher percentage reported an STI (17.4%). Since there are over 30 categories in each country with various combinations, we do not have sufficient degrees of freedom to statistically compare each category, nor does it always make conceptual sense (e.g. it is difficult to derive meaning from a comparison of self-reported STI for men with 1 wife, 1 girlfriend and 1 sex worker to men with 2 girlfriends and a casual partner, other than to say that there is a difference). We attempt to deal with some of these analytical roadblocks with our analytic strategy examining relationship combinations and condom use in the next section.

[TABLE 3 and 4. HERE]

Relationship type combinations and condom use

Our final aim was to explore the extent to which condom use with one partner is associated with the relationship type of the man's *other* concurrent relationships. In order to use the available data to assess this, we focused on condom use with

girlfriends since it was the only relationship type with sufficient sample size. Further, since we wanted to isolate the effect of men's *other* concurrent relationship types on their condom use with a girlfriend, we limited our sub-sample to those men with at least two girlfriends (i.e. 2 girlfriends and 1 wife, 2 girlfriends and 1 live-in girlfriend, 3 girlfriends, 2 girlfriends and 1 casual acquaintance, 2 girlfriends and 1 sex worker). This resulted in sufficient sample size to compare the five groups, and also allowed us to assess the association between the relationship type of the other partner on condom use with the girlfriend. This sub-sample of men with at least two girlfriends included 573 men (71.6%) in Ghana and 578 men (71.6%) in Tanzania. Among men with the five relationship combinations fitting our criteria, we found that condom use with girlfriends is significantly associated with relationship type combination (GH: wald χ^2= 29.87, df=4, p<.0001; wald χ^2= 9.42, df=4, p=0.05).

For condom use at last sex *with girlfriends,* rates were lowest (GH: 55.4%; TZ: 51.1%) when men's relationship type combination included 2 girlfriends and 1 sex worker and highest with the relationship type combination of 2 girlfriends and 1 wife (GH: 77.5%; TZ: 73.7%). Examining men who had 2 girlfriends and 1 sex worker as a reference category for both countries, we found that men were significantly more likely to report condom use with girlfriends when the third relationship type was a wife (Ghana: OR 2.8, 95%CI=1.3, 5.8; Tanzania: OR 2.7, 95%CI=1.6, 4.5). In Ghana, condom use with girlfriends was not significantly different than the reference for other combinations, though rates of condom use

increased as the other partner relationship type became less casual. Lack of other significant results in Ghana may be due to small sample size of men with 2 girlfriends and 1 sex worker in Ghana (n=37). In Tanzania, however, compared to men with 2 girlfriends and 1 sex worker partner, men were also significantly more likely to report using a condom with a girlfriend at last sex if they had 2 girlfriends and a live-in girlfriend (OR 2.1, 95%CI=1.1, 3.8) or had 3 girlfriends (OR 2.8, 95%CI=1.8, 4.2). In both countries, the overall trend was that the proportion using condoms with girlfriends decreased when the other relationship type was more casual. These associations held when controlling for age, education and salary.

[TABLE 4. HERE]

DISCUSSION

Our study analyzed data from a unique sample of high-risk men in Ghana and Tanzania with at least three partners in the past three months. We used this rich source of data on relationships to assess the connection between relationship types, relationship type combinations, and condom use at last sex. We found that different relationships types and combinations are associated with condom use. In this section, we review the results and discuss important considerations for future HIV prevention efforts with high-risk men.

In general, the distribution of relationship types and condom use with each relationship type were similar for each country. Considering the major differences in HIV prevalence and cultural context between the two study sites (18), this suggests that the association between relationship type and condom use in sub-Saharan Africa is not necessarily unique to the country context.

Overall, the majority of the relationships reported by the men in our samples were self-described as girlfriends. Notably, the majority of these men were not married nor had a live-in partner. Over two-thirds of men's relationship combinations included at least two girlfriends. As with previous studies of relationship type and condom use, we found a precipitous increase in condom use as the relationship type was more casual. We also found that the combination of partners is potentially an important determinant of condom use with girlfriends.

Importance of relationships with 'girlfriends'

Two-thirds of all relationships in both sites were described by the men as a girlfriend. Further, one-third of all men reported that all three of their most recent sexual partners were considered girlfriends. Condom use with girlfriends was 63.3% in Ghana and 69.3% in Tanzania, though we noted that this proportion ranged between 51.1% and 77.5% depending on the type of the man's other concurrent relationships. Public health has struggled to promote condom use between spouses and steady partners but has had greater success promoting

condom use between sex workers and their clients (19). Success promoting condoms between boyfriends and girlfriends has been more tempered. Our findings suggest that increases in condom use with girlfriends can potentially reduce HIV transmission in populations of high-risk men due to the large numbers sexual encounters reported with girlfriends.

While a majority of men used condoms at last sex with their girlfriends, men who also had a sex worker partner had lower than average rates of condom use with girlfriends by about 10%. The determinants of condom use with girlfriends is underexplored, especially in the context of concurrent relationships. Future research needs to examine the different characteristics and relationship dynamics between men and their girlfriends in order to develop interventions to promote HIV risk reduction behaviors, such as increased condom use.

Risk and concurrent relationships

Among men with at least two girlfriends, men from both sites with a sex worker partner report lower rates of condom use with girlfriends than men without a sex worker partner. Sex workers are widely seen as the 'riskiest' sexual partner because of their relatively high rates of HIV prevalence worldwide (20). Our data seem to support the notion that men with partners who are sex workers may be at higher risk for STIs since men with relationship combinations including a sex worker self-reported STIs more than other men. However, the potential mechanisms contributing to this increased risk need further exploration. Our

data suggest that men's increased risk could stem in part from their lower rates of condom use with their *girlfriends*. Of all men who had 2 girlfriends and an additional partner, men whose other partner was a sex worker reported the lowest rates of condom use with a girlfriend. Their increased self-reports of STIs could be due to less condom use with the girlfriends, rather contracting STIs from the sex workers themselves. Our data do not allow for further exploration into this possibility, but future research should explore risk related to lower condom use with girlfriends.

Men may be conducting a 'risk comparison': men might perceive girlfriends as less likely to have STIs or HIV when they are comparing them to their sex worker partners, but more likely to have STIs or HIV if they are comparing them to their wife. This comparison could influence their risk perception and change their likelihood of using a condom with a girlfriend. It is also possible that their higher rates of condom use with girlfriends when they have a wife stems from preventing an unwanted extramarital pregnancy or protecting the wife from STI/HIV.

Future HIV prevention messaging

HIV prevention messaging has been successful at communicating the risk of sex worker partners, but needs to better communicate risk in concurrency, no matter the relationship. Successful messaging around protecting oneself outside the home may be less relevant for men who do not have wives or a live-in partner as

few of the men in our study reported. Relationships with girlfriends, rather than wives, may be more salient for the men in our study. Additional messaging around the dangers of casual sex (zero grazing, etc.) may also be missing the mark for these men. HIV prevention messaging needs to adapt to develop effective messaging and programming that can effectively communicate the potential risk of relationships with girlfriends to men with multiple concurrent relationships.

Strengths and Limitations

This study is the first to examine the associations between relationship combinations and condom use among high-risk men in sub-Saharan Africa. Additionally, this rich source of data on high-risk men's relationships provides important data on the types of relationships that men with concurrent partners have. But, this study is not without limitations. First, we assume concurrency even though we do not have detailed data on when each relationship started and ended. We feel comfortable doing so given the relatively short window (3 months) in which these relationships co-occurred. Second, since this analysis was exploratory, we were unable to conduct an in-depth analysis on all of the correlates of condom use for each relationships type and combination. We hypothesize that the influence of men's other concurrent relationship types on condom use is mediated by relationship characteristics, but without longitudinal data, we are unable to establish temporality and test our mediation hypothesis.

Finally, we relied on self-reported condom use which is subject to social desirability bias.

CONCLUSION

Studies of concurrency have largely ignored the potentially differential risk based on different types of concurrency combinations. Our data suggest that condom use is associated with men's concurrent relationship type combinations. Future research of the role of concurrency in driving HIV transmission in sub-Saharan Africa may need to consider different types of concurrency and their differential effect on HIV risk.

Table 1. Demographic characteristics of the men and relationship types

		Tema, Ghana	Mbeya, Tanzania
Sample size		800	807
Age	Mean (SD)	28.3 (5.96)	29.5 (6.25)
Age in years (%)			
18 to 24		27.1	20.7
25 to 29		40.5	34.3
30 to 34		16.5	23.4
35 to 39		9.8	11.9
40 to 49		6.1	9.7
Monthly Salary [USD]*	Mean (SD)	169.9USD (266.0USD)	195.2USD (142.9USD)
Self-reported STI(%)		16.5	20.8
Marital Status (%)			
Married		16.1	24.0
Living with Someone		6.9	13.0
Widowed		--	3.0
Single		77.0	60.0
Has co-wives (%)		1.1	3.0
Number of children	Mean (SD)	0.72 (1.04)	0.92 (1.39)
Highest level of schooling (%)			
Primary or Less		5.9	26.6
Middle School		26.6	38.5
Secondary/Vocational		44.5	17.1
Post Secondary		23.0	17.7
Total # of relationships		2367	2392
Relationship types (% of all relationships)			
Wife		94 (4.0%)	194 (8.1%)
Live-in GF		103 (4.4%)	101 (4.2%)
GF		1607 (67.9%)	1562 (65.3%)
Casual		374 (15.8%)	341 (14.3%)
CSW		189 (8.0%)	194 (8.1%)

Table 2. Relationship type and condom use for all reported relationships

Relationship type	*Freq of Relationship (%)*	*Condom use at last sex (%)*	*Odds Ratio for condom use at last sex**	*Adjusted Odds Ratio***
GHANA (n=2367 relationships)				
Wife	94 (4.0)	13.8	REF	REF
Live-In GF	103 (4.4)	31.1	**2.81 (1.35, 5.86)**	**3.09 (1.46, 6.52)**
Non-live in GF	1607 (67.9)	63.3	**10.74 (5.93, 19.46)**	**11.15 (6.02, 20.65)**
Casual Acq.	374 (15.8)	78.3	**22.54 (11.77, 43.15)**	**23.86 (12.18 46.74)**
Sex Worker	189 (8.0)	82.0	**28.40 (13.58, 59.41)**	**32.46 (15.16, 69.53)**
TANZANIA (n=2392 relationships)				
Wife	194 (8.1)	8.8	REF	REF
Live-In GF	101 (4.2)	27.7	**3.99 (1.98, 8.06)**	**4.95 (2.35, 10.44)**
Non-live in GF	1562 (65.3)	69.3	**23.54 (13.51, 41.03)**	**30.90 (16.93, 56.39)**
Casual Acq.	341 (14.3)	75.1	**31.36 (17.30, 56.84)**	**36.99 (19.63, 69.70)**
Sex Worker	194 (8.1)	76.8	**34.47 (17.57, 67.64)**	**46.88 (22.60, 97.23)**

Bolded means the odds ratio is significantly different than 1 ($p<.05$)

*Accounting for clustering at the man level and venue level

**Adjusted for education, salary, and age

Table 3. Characteristics of men in Tema, Ghana by their relationship combination

	3 GFs	2 GFs & 1 Casual	1 GF & 2 Casual	2 GFs & 1 Wife	2 GFs & 1 Live-in GF	2 GFs & 1 CSW	1 GF, 1 Casual & 1 CSW	1 GF & 2 CSW	1 Live-in GF, 1 GF, & 1 Casual	3 CSW
# of men	300	121	66	60	55	37	28	17	15	12
% of men	37.5	15.13	8.25	7.5	6.88	4.63	3.5	2.13	1.88	1.5
Age[a,b,c]										
Mean Age	27.2	26.6	26.1	34.4	28.7	28.4	28.5	29.8	27.5	32.5
(SD)	(5.8)	(4.5)	(4.0)	(6.2)	(5.4)	(5.2)	(4.6)	(7.6)	(4.0)	(5.9)
STI in last month (%)[a,b]										
	14.7	17.4	13.6	11.7	16.4	21.6	21.4	41.2	13.3	16.7
Salary[a]										
Mean	162.2	132.4	154.5	211.4	149.4	279.3	140.9	84.9	185.9	99.3
(SD)	(339.6)	(139.2)	(292.9)	(147.7)	(131.6)	(264.9)	(181.7)	(94.2)	(251.3)	(83.2)
Education (%)[a,b,c]										
None	0.3	0.0	0.0	3.3	5.5	0.0	3.6	0.0	0.0	8.3
Primary	3.0	2.5	1.5	8.3	5.5	2.7	3.6	11.8	6.7	16.7
MidSch	30.0	18.2	26.2	20.0	36.4	37.8	28.6	11.8	33.3	16.7
Secondary	44.3	52.9	50.8	56.7	36.4	29.7	35.7	47.1	40.0	50.0
Post-sec	22.3	26.5	21.6	11.7	16.3	29.7	28.6	29.4	20.0	8.3
GEM Score Tertiles (%)[a,b,c]										
Equitable	30.3	44.6	43.9	25.0	32.7	27.0	28.6	11.8	33.3	33.3
Average	34.7	26.4	33.3	41.7	36.4	27.0	25.0	47.1	40.0	16.7
Inequitable	35.0	28.9	22.7	33.3	30.9	45.9	46.4	41.2	26.7	50.0

* USD rate for Ghanaian Cedi calculated for September 1, 2008. 1 GHC = 0.849 USD. The following converting website was used: http://www.oanda.com/currency/converter/

[a] Chi-squared test for difference between all 34 combination is significant, p<.0001

[b] Chi-squared test for difference between top 10 combination (those presented in this table) is significant, p<.0001

[c] Chi-squared test for difference between the 5 combinations with at least 2 'girlfriends' is significant, p<.0001

Table. 4. Characteristics of men in Mbeya, Tanzania by their relationship combination

	3 GFs	2 GFs & 1 Wife	2 GFs & 1 Casual	2 GFs & 1 CSW	2 GFs & 1 Live-in GF	3 Casual	2 Casual & 1 GF	1 GF, 1 Wife, & 1 Casual	1 GF & 2 CSW	1 GF, 1 Wife, & 1 CSW
# of men	281	93	75	69	60	36	31	20	15	14
% of all men	34.8	11.5	9.3	8.6	7.4	4.5	3.8	2.5	1.9	1.7
Age[a,b,c]										
Mean Age	27.9	34.7	28.0	28.4	29.5	26.4	27.4	36.0	27.1	33.9
SD	(6.1)	(6.2)	(5.3)	(4.5)	(4.7)	(3.5)	(6.7)	(5.2)	(5.0)	(5.8)
STI in last month[a,b,c]										
Yes (%)	18.9	21.7	13.3	29.0	33.9	5.6	13.3	20.0	46.7	46.2
Salary[a,b,c]										
Mean	164.4	269.6	203.8	191.6	173.6	150.7	128.7	314.8	174.3	255.7
SD	(128.6)	(165.0)	(162.7)	(129.7)	(118.0)	(96.4)	(90.8)	(141.8)	(127.1)	(124.7)
Education[a,b,c]										
None (%)	1.1	2.2	0.0	1.5	1.7	0.0	0.0	0.0	0.0	0.0
Primary(%)	30.6	18.3	14.7	32.4	30.0	22.2	22.6	5.0	46.7	35.7
MidSch (%)	42.0	32.3	36.0	48.5	36.7	19.4	32.3	40.0	40.0	7.1
Secondary(%)	13.9	22.6	26.7	8.8	16.7	19.4	16.1	20.0	13.3	28.6
Post-sec (%)	12.5	24.7	22.7	8.8	15.0	38.9	29.0	35.0	0.0	28.6
GEM Score Tertiles[a,b,c]										
Equitable (%)	29.9	53.8	40.0	15.9	38.3	36.1	35.5	45.0	0.0	7.1
Average (%)	29.5	31.2	30.7	36.2	18.3	44.4	51.6	45.0	40.0	35.7
Inequitable(%)	40.6	15.1%	29.3	47.8	43.3	19.4	12.9	10.0	60.0	57.1

* USD rate for Tanzania Shilling calculated for February 1, 2009. 1 TZS = 0.00076 USD. The following converting website was used: http://www.oanda.com/currency/converter/

[a] Chi-squared test for difference between all 34 combination is significant, p<.0001

[b] Chi-squared test for difference between top 10 combination (those presented in this table) is significant, p<.0001

[c] Chi-squared test for difference between the 5 combinations with at least 2 'girlfriends' is significant, p<.0001

Table 5. Condom use by relationship type combination

Relationship type combination	*Condom use (%) with GF*	*Odd ratios for Condom use with GF**	*Adjusted Odds Ratios***
TEMA, GHANA			
2 GFs and 1Wife	77.5	**2.77 (1.32, 5.84)**	**3.10 (1.40, 6.86)**
2 GFs and 1 Live-in	70.0	1.88 (0.93, 3.78)	1.98 (0.95 4.16)
3 GFs	64.0	1.43 (0.84, 2.43)	1.37 (0.79, 2.37)
2 GFs and 1 Casual	63.2	1.38 (0.77, 2.48)	1.31 (0.72, 2.42)
2 GFs and 1 CSW	55.4	REF	REF
MBEYA, TANZANIA			
2 GFs and Wife	73.7	**2.67 (1.59, 4.50)**	**2.34 (1.35, 4.06)**
2 GFs & Live-in	68.3	**2.06 (1.12, 3.81)**	**1.91 (1.04, 3.51)**
3 GFs	74.3	**2.77 (1.83, 4.20)**	**2.78 (1.82 4.25)**
2 GFs and Casual	61.7	1.54 (0.93, 2.56)	1.27 (0.75, 2.15)
2 GFs and CSW	51.1	REF	REF

Bolded means the odds ratio is significantly different than 1.00 ($p<.05$)
*Accounting for clustering at the man level and venue level
**Adjusted for education, salary, and age

REFERENCES

1. Morris M, Kretzschmar M. Concurrent partnerships and the spread of HIV. AIDS 1997;11(5):641-8.
2. Halperin DT, Epstein H. Concurrent sexual partnerships help to explain Africa's high HIV prevalence: implications for prevention. Lancet 2004;364(9428):4-6.
3. Garnett GP, Johnson AM. Coining a new term in epidemiology: concurrency and HIV. AIDS 1997;11(5):681-3.
4. Wawer MJ, Gray RH, Sewankambo NK, Serwadda D, Li X, Laeyendecker O, et al. Rates of HIV-1 transmission per coital act, by stage of HIV-1 infection, in Rakai, Uganda. J Infect Dis 2005;191(9):1403-9.
5. UNAIDS. Global Report: UNAIDS Report on the Global AIDS Epidemic 2012. Geneva: UNAIDS; 2012.
6. Morris M. Barking up the wrong evidence tree. Comment on Lurie & Rosenthal, "Concurrent partnerships as a driver of the HIV epidemic in sub-Saharan Africa? The evidence is limited". AIDS Behav 2010;14(1):31-3; discussion 34-7.
7. Lurie MN, Rosenthal S. Concurrent partnerships as a driver of the HIV Epidemic in sub-Saharan Africa? The evidence is limited. AIDS Behav 2010;14(1):17-24; discussion 25-8.
8. Padian NS, Manian S. The concurrency debate: time to put it to rest. Lancet 2011;378(9787):203-4.
9. Kretzschmar M, Carael M. Is concurrency driving HIV transmission in sub-Saharan African sexual networks? The significance of sexual partnership typology. AIDS Behav 2012;16(7):1746-52.
10. UNAIDS Reference Group on Estimates Modelling and Projections. HIV: consensus indicators are needed for concurrency. Lancet 2010;375(9715):621-2.
11. Mah TL. Prevalence and correlates of concurrent sexual partnerships among young people in South Africa. Sex Transm Dis 2010;37(2):105-8.
12. Sawers L, Stillwaggon E. Concurrent sexual partnerships do not explain the HIV epidemics in Africa: a systematic review of the evidence. J Int AIDS Soc 2010;13:34.
13. Glynn JR, Dube A, Kayuni N, Floyd S, Molesworth A, Parrott F, et al. Measuring concurrency: an empirical study of different methods in a large population-based survey and evaluation of the UNAIDS guidelines. AIDS 2012;26(8):977-85.
14. Westercamp N, Mattson CL, Madonia M, Moses S, Agot K, Ndinya-Achola JO, et al. Determinants of consistent condom use vary by partner type among young men in Kisumu, Kenya: a multi-level data analysis. AIDS Behav 2010;14(4):949-59.
15. Ghana AIDS Commission. 2004 HIV Sentinel Survey Report. Accra, Ghana: Ghana AIDS Commission; 2004.
16. National bureau of Statistics [Tanzania], Macro International Inc. Tanzania HIV/AIDS and Malaria Indicator Survey: Key Findings. Calverton, Maryland, USA: NBS and Macro International Inc. ; 2009.
17. Riedner G, Rusizoka M, Hoffmann O, Nichombe F, Lyamuya E, Mmbando D, et al. Baseline survey of sexually transmitted infections in a cohort of female bar workers in Mbeya Region, Tanzania. Sex Transm Infect 2003;79(5):382-7.

18. Eaton JW, Hallett TB, Garnett GP. Concurrent sexual partnerships and primary HIV infection: a critical interaction. AIDS Behav 2011;15(4):687-92.
19. Foss AM, Hossain M, Vickerman PT, Watts CH. A systematic review of published evidence on intervention impact on condom use in sub-Saharan Africa and Asia. Sex Transm Infect 2007;83(7):510-6.
20. Baral S, Beyrer C, Muessig K, Poteat T, Wirtz AL, Decker MR, et al. Burden of HIV among female sex workers in low-income and middle-income countries: a systematic review and meta-analysis. Lancet Infect Dis 2012;12(7):538-49.