Multiple Concurrent Partnerships in a sub-Saharan setting: Biases in Self-Reported Measures and Their Implications for HIV/AIDS Prevention

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Abstract

Multiple concurrent partnerships (MCP) have been described as the "key driver" of generalized HIV epidemics, but comparative studies show that MCP are not more common in regions of Africa with high HIV prevalence than in regions with concentrated epidemics. This might be due to systematic under-reporting of MCP during population-based sexual behavior surveys (e.g., DHS). We use unique sexual network data from a small island population on Lake Malawi, in conjunction with a simple model of HIV transmission, to assess whether self-reported measures of partnership concurrency possibly underestimate the contribution of MCP to HIV epidemics in sub-Saharan settings. We find that the prevalence of MCP was significantly higher in this population according to estimates derived from network data. Self-reported data underestimated the proportion of incident infections attributable to MCP by more than 50% on average. Our results emphasize the need for interventions addressing patterns of sexual networking and multiple partnerships at the population level rather than focusing on the transmission of HIV within stable cohabiting couples.

Keywords: concurrency, survey data, sexual behaviors, HIV transmission, HIV risk factors, Malawi.

Multiple concurrent partnerships (MCPs)—defined as having 2 or more sexual partnerships that overlap in time—can accelerate the transmission of sexually transmitted infections (including HIV) in a population (Koumans et al. 2001; Kretzschmar and Morris 1996; Morris and Kretzschmar 1995; Potterat et al. 1999), and have recently been described as the "key driver" behind the generalized epidemics of southern and eastern Africa(Shelton 2007). However comparative studies of the factors of HIV infection in sub-Saharan Africa suggest that MCP are not more common in regions with a high prevalence of HIV (Lagarde et al. 2001). Several factors may blur the association between partnership concurrency and HIV infection in empirical studies: first, epidemiological surveys focus on recent MCP (e.g., over the last year) rather than on past MCP during which HIV is likely to have been transmitted (Rothenberg et al. 2002); second, the omission of significant confounders such as male circumcision (Lagarde et al. 2001) or blood exposures to HIV (e.g., injections) (Rothenberg et al. 2002) may hide the relation of interest; third, analyzes of the role of concurrency in SSA have focused on HIV acuqisition, and have not investigated the *transmission* of HIV to the partners of an index case (Koumans et al. 2001; Morris 2001; Potterat et al. 1999). In this paper, we consider the plausibility of a fourth hypothesis: can the lack of association between MCP and HIV risk in sub-Saharan populations be due to the limited validity of survey data on MCP? This hypothesis has been formulated (Boerma et al. 2003; Lagarde et al. 2001) but has not been tested. In this paper, we use unique data on the sexual networks of a small island population of Lake Malawi (Helleringer and Kohler 2007), in conjunction with a simple mathematical model of HIV transmission, to assess whether self-reported measures of partnership concurrency possibly underestimate the contribution of MCP to HIV epidemics in sub-Saharan settings. Sexual network studies that incorporate partner tracing may be less vulnerable to under-reporting of sexual relationships because one's relationship(s) are potentially reported not only by the respondent him/herself, but also by his/her sexual partner(s). Accurate information on MCP and sexual networking is primordial as preventive interventions targeting partnership concurrency are advocated and rolled-out on a large scale (e.g., Green 2003; Potts et al. 2008; UNAIDS 2007).

1 Methods

1.1 General Approach

The frequency of MCP in a population is generally established by asking a random sample of survey respondents if (some of) their recent sexual relationships overlapped in time (e.g., Lagarde et al. 2001). These data are however often inaccurate because respondents may not report stigmatized behaviors (e.g., non-marital relations) during surveys (e.g., Cleland et al. 2004; Mensch et al. 2003). For example, if respondent A in Figure 1a reports only one his/her relationship and omits the other and respondent E reports only one of his four relationships, then neither individual A nor E would be classified as engaged in a MCP based on self-reported survey data. As a result, the impact of MCP on HIV transmission may be underestimated.

In network studies based on partner tracing designs (see Morris 2004), researchers do not sample respondents but rather attempt to enroll all members of a defined population in the study. Eligible respondents are then asked to nominate their sexual partners, and nominated partners are then matched to existing population rosters (e.g., Bearman et al. 2004; Helleringer and Kohler 2007). All data are linked and allow reconstructing chains of sexual relations connecting members of the population of interest. Such data may be less vulnerable to under-reporting of sexual relationships because one's relationship(s) are potentially reported not only by the respondent him/herself, but also by his/her sexual partner(s). For example, while in figure 1a, we are not able to classify A and E as engaged in a MCP based on their self-reports, the reports made by A and E's partners allow us to correctly identify A and E as being involved in a MCP (Figure 1b).

The number of sexual partners a respondent reports during a sexual network survey is sometimes called the ”outdegree” (Wasserman and Faust 1994). The number of times a respondent is nominated by other survey respondents during a sexual network survey, on the other hand, is the “indegree”. The combination of indegrees and outdegrees is referred to as the ”total degree” of a respondent. If self-reports of sexual behaviors were perfectly accurate, outdegree, indegree and total degree would be equal for each member of the network. In the presence of under-reporting however, the measures diverge. In this paper, we systematically compare inferences about the role of MCP in HIV transmission made on the basis of outdegrees alone to inferences made on the basis of total degrees.

1.2 Data

1.2.1 Sexual Network Survey

Our analysis is based on the Likoma Network Study (LNS), which traced the sexual networks of young adults on Likoma, a small island in the northern region of Lake Malawi (Helleringer and Kohler 2007; Helleringer et al. 2006). During November 2005 and February 2006 the LNS implemented a sexual network survey that was based on three steps. First, in November 2005, we completed a household census during which we enumerated all inhabitants of the island. The main aim of this census was to constitute rosters of potential sexual network members. Second, from January to mid-February 2006, we conducted a sexual network survey with all inhabitants aged 18–35 in seven villages of the island. Respondents were asked to provide the names (along with other identifying information such as residence, occupation . . .) of up to 5 of their recent sexual partners during computer-assisted interviews. They were also asked to answer questions about the context of their relationships with these partners (e.g., duration and timing), and relationship-specific risk factors for HIV transmission (e.g., condom use). Interviews were conducted using audio computer-assisted self-interviewing techniques (ACASI), which have been shown to significantly increase the validity of reports of stigmatized behaviors in other contexts (e.g., Mensch et al. 2003). The network of sexual relationships was then constructed by tracing all nominated partners and linking, where possible, nominated partners to survey respondents and individuals included in the household roster. More than 80% of partners residing on Likoma were traced. Third, during March 2006, study participants were tested for HIV infection using two rapid tests as suggested by the Malawi Ministry of Health.

1.2.2 Definitions

In our study, we measure partnership concurrency directly at the time of the survey, by counting how many sexual partnerships respondents were involved in at the time of the survey. This approach does not capture the total effects of partnership concurrency on HIV spread (Lagarde et al. 2001; Morris and Kretzschmar 1997), but has been used in comparative reviews (e.g., Halperin and Epstein 2004). The distribution of ongoing partnerships (sometimes called the "instantaneous degree distribution") is also used extensively in mathematical modeling of epidemic spread (e.g., Morris and Kretzschmar 1997).

We refer to respondents with outdegree ≤ 1 as having "self-reported serial partnerships" (SR-SP), and respondents with outdegree ≥ 2 as having "self-reported multiple concurrent partnerships" (SR-MCP). Finally, we refer to respondents who self-reported being engaged in at most one sexual relationship (outdegree ≤ 1), but were nominated by at least one other respondent (total degree ≥ 2), as having "network-reported MCPs" (NR-MCP). Respondents with network-reported MCPs would not be identified as having concurrent partnerships according to self-reported data since their outdegree is equal to one.

Individual-level risk factors for HIV transmission elicited by the LNS were self-reported symptoms of STI, last time sought treatment for STI, last time received an injection, recent symptoms indicative of infection with *plasmodium falciparum* and HIV testing behavior. Symptoms of STI, last time sought STI treatment and last time received an injection were all ascertained over the year prior to the survey and were coded "1" if the respondent experienced these events during that time span, and zero otherwise. Symptoms of STI which were assessed included painful urination, ulceration of the genital area or discharge from the penis/vagina. The variable was coded "1" if the respondent experienced any of these symptoms, and 0 otherwise. HIV testing behavior was measured by a variable describing whether a respondent had ever been tested for HIV infection prior to the study. Condom use is described by two variables: having ever used a condom with a current partner and consistency of use with all partners. Condom use was defined as consistent when a respondent reported "always" using a condom with a given partner. Consistency of condom use was not assessed in marital relationships.

1.3 Analytic strategy

1.3.1 Statistical analysis

We examine the association between MCP and HIV risk factors by fitting logistic regression models with concurrency (measured by self-reported or network data) as an independent variable. We examine associations separately for men and women, and models include controls for age group and marital status (never married vs. ever married). We further assess differences in HIV risk factors between in MCP by fitting models that include SR-SP, SR-MCP and NR-MCP as different levels of an independent categorical variable (with SR-SP as the reference category). We conduct Wald tests to assess whether the odds ratios of SR-SP vs. SR-MCP, and SR-SP vs. NR-MCP were homogeneous (Agresti 1990). Standard errors of the estimates are adjusted for the clustering of observations within study villages.

1.3.2 Modelling analysis

We devise a simple model based on aggregate population-level patterns of partnership concurrency to estimate the proportion of incident HIV infections attributable to MCP according (equations 1).

$$
\begin{aligned}
Trans_{ij} &= \beta \times P_{inf,i} \times P_{susc,j} && (1)\\
N &= \sum_{d_i=1}^{d_{i,max}} (d_i \times Trans_{ij}) && (2)\\
N_{concurrent} &= \frac{\sum_{d_i=2}^{d_{i,max}} (d_i \times Trans_{ij})}{N} && (3)\\
& && (4)
\end{aligned}
$$

For each individual within this population, the probability of transmitting HIV during a relationship is a product of the probability that this relationship is sero-discordant ($P_{inf,i} \times P_{susc,j}$) and the instantaneous risk of transmitting HIV, β. We use these probabilities to calculated the expected number incident HIV infections from all relationships (N) and used these figures to estimate what proportion of incident heterosexually transmitted HIV infections were attributable to concurrent relationships $N_{concurrent}$. Our model used the assumptions that (1) all serodiscordant sexual relationships have an equal probability of HIV transmission per unit of time, and

(2) that the distribution of HIV within the sexual networks is approximately constant within the time interval considered. Our model thus is based on aggregate population-level patterns of sexual partnerships, and to produce estimates it requires only counts of the individual number of partner d_i. $P_{inf,i}$ and $P_{susc,j}$ are assigned on the basis of HIV prevalence observed during the study (Helleringer et al. 2006). We compare estimates of equations 1 according to outdegrees and total degrees.

2 Results

2.1 Descriptive statistics

923 respondents participated in the sexual network survey and made a total of 851 reports of sexual relationships that were ongoing at the time of the survey. 17.8% of all relationships of women and 15.8% of all relationships of men were reported only by partners of the respondent (Figure 2). 536 reports of relationships collected during the survey were to other survey respondents, and among these "in-sample" relationships, 27% of the relationships of women and 21.8% of relationships of men were reported only by their partners.

Table 2.1 describes respondents' characteristics and the extent of their sexual networking according to self-reported data (outdegrees) and network data (total degrees). 36.9% of women and 52.3% of the men interviewed had never been married, and 10.8% of women were widowed or divorced. 21.1% of women and 22.6% of men reported not being involved in a relationship at the time of the survey (outdegree=0). However, 43 of those were nominated by other respondents (indegree $\geq$ 1). As a result, only 14.9% of women and 19.0% of men were not in an ongoing partnership at the time of the survey. The proportion of respondents with 2 or more concurrent partnerships at the time of the survey was significantly higher according to network data (total degrees): 6.8% of women self-reported being involved in a MCP, but reports of relationships made by other respondents identified an additional 38 female respondents as engaged in a MCP. Similarly, 15.4% of men self-reported being engaged in a MCP, but reports made by partners identified an additional 34 male respondents as having MCP. Self-reports of sexual relationships underestimated the prevalence of MCP in this population by 112% for women and 52.3% for men, when compared to network data.

2.2 HIV Risk factors associated with partnership concurrency

Table 2 compares the prevalence of co-factors and attitudes related to the risk of HIV transmission among MCP, according to self-reported and network data. It indicates that self-reported data may underestimate the infectivity of individuals with MCPs, among both men and women. While self-reports of MCP indicate that women with SR-MCP did not differ from the rest of population with regards to HIV co-factors, estimates derived from network data indicate otherwise: women in MCP were generally more likely to have used condoms with any of their current partners, but were significantly less likely to have done so consistently . While these findings may be due to the small number of women with SR-MCP, we did find additional evidence that the prevalence of STIs was significantly higher among women with NR-MCP relative to women with SR-MCP ($p \approx 0.09$). Among men, the prevalence of condom use was higher among MCP than among men in serial relations according to self-reported data, as was the proportion of men worrying about

Table 1: Characteristics of relationships identified during the sexual network interview. Ongoing relationships.

	Women $N = 501$	**Men** $N = 422$
Respondents' characteristics		
Age		
Less than 20	22.5%	17.8%
20–24	31.6%	33.2%
25–29	25.3%	21.1%
30–34	13.0%	13.5%
35 and more	7.6%	14.2%
Marital status		
Never married	36.9%	52.3%
Currently married	52.3%	44.9%
Widowed or divorced	10.8%	2.8%
Outdegrees†		
0	21.1%	22.6%
1	72.1%	62.0%
2	5.6%	11.6%
3	1.0%	2.8%
4	0.2%	1.0%
Total Degrees‡		
0	14.9%	19.0%
1	70.7%	57.5%
2	11.0%	17.1%
3	3.0%	5.5%
4	0.4%	0.9%

Notes:
†Number of relationships self-reported by respondents during the sexual network survey.
‡Number of relationships self-reported by respondents or reported by respondent's partners during the sexual network survey.

HIV. According to network data, however, several other co-factors enhancing HIV transmission risks were more common among men with MCP including recent use of injections and recent episodes of malaria/flu-like illnesses. In addition, men with NR-MCP were significantly less likely to be worried about HIV, but were more likely to report less consistent condom use than men with SR-MCPs, .

2.3 Biases in estimated contribution of MCP to HIV transmission

In table 3, we report estimates of the proportion of incident infections due to MCP. We assumed a short time-horizon (e.g., 1 moth) and assumed that the probability of transmission through sero-discordant marital partnerships during that time was 0.01. In our first set of models, we assumed that respondents choose their partners at random within the population. According to self-reported data, this model predicts that between 20.3% and 26.7% of all incident infections occur through concurrent partnerships (depending on the relative infectivity of non-marital relations, P^m/P^{nm}). According to network data, however, the relative contribution of MCP to HIV transmission is significantly increased: more than a third of new infections are attributable to concurrent partnerships according to network data. Self-reported data underestimate the impact of partnership concurrency on HIV transmission by more than 50% on average.

3 Discussion

In this small sub-Saharan population, the systematic comparison of partner-reported network data and self-reported sexual partnership data highlighted several important biases in self-reported sexual behavior data. First of all, self-reported data significantly underestimated the prevalence of partnership concurrency within this population. Second, several co-factors potentially enhancing the transmission of HIV during sexual intercourse were more common among respondents with NR-MCP than among the rest of the population. Third, self-reports of MCP also underestimated the proportion of incident HIV infections attributable to MCP according to a simple model of HIV transmission.

The findings presented here thus agree with findings from several other studies having documented large and systematic under-reporting of sexual relationships sub-Saharan populations (e.g., Cleland et al. 2004; Dare and Cleland 1994,?; Gregson et al. 2004; Mensch et al. 2003; Nnko et al. 2004). However, while these studies have generally stigmatized "swaggering" men and "secretive women", we found that both men and women under-reported the extent of their sexual networking. In addition, several risk factors affecting the risk of onward HIV transmission were significantly more common in concurrent relationships misclassified by self-reported data and among respondents involved in these relationships. For example, condom use was less less consistent during non-reported concurrent partnerships of women and men. Women with NR-MCP were also more likely to present recent symptoms of STIs than women in serial relations, and because co-infection with STIs act as an important amplifier of HIV transmission risks (e.g., Cohen et al. 1997; Krieger et al. 1995), their infectivity could thus be significantly increased. Men with NR-MCP were more likely to report having recently experienced symptoms indicative of malaria or a flu-like illness than men in serial relations. Because systemic co-infection (in particular with *Plasmodium falciparum* malaria)is another important amplifier of HIV transmission risk (Kublin

Table 2: Prevalence of co-factors of HIV transmission among respondents with MCP according to self-reported and network data. Age and marital status adjusted Odds Ratios.

	Women			**Men**		
	Self-reported *OR [95%CI]*	Network *OR [95%CI]*	Homogenous OR† *p-value*	Self-reported *OR [95%CI]*	Network *OR [95%CI]*	Homogenous OR† *p-value*
Self-reported STI symptoms						
Ref=No symptoms						
At least one symptom	1.36 [0.79,2.32]	1.93 [0.87,4.27]*	0.09	1.01 [0.60,1.69]	0.96 [0.41,2.24]	0.79
Last Sought STI treatment						
Ref=Never sought or > 1 year ago						
Over the last year	1.53 [0.47,5.03]	1.08 [0.43,2.75]	0.28	1.89 [0.42,8.44]	1.25 [0.27,5.89]	0.01
Last time received an Injection						
Ref=Never received or > 1 year ago						
Within last year	1.38 [0.79,2.42]	1.12 [0.60,2.10]	0.39	0.84 [0.53,1.32]	1.41 [1.18,1.70]**	< 0.01
Malaria symptoms						
Ref=No recent symptoms						
Recent symptoms	1.33 [0.62,2.81]	0.95 [0.60,1.52]	0.31	1.13 [0.78,1.63]	1.41 [0.86,2.31]	0.21
HIV testing prior to study						
Ref=Never tested						
Ever tested	1.32 [0.52,3.37]	1.15 [0.69,1.93]	0.60	1.61 [1.03,2.53]**	1.80 [1.05,3.10]**	0.82
HIV risk perception						
Ref=Not worried at all						
Worried a little/worried a lot	1.37 [0.69,2.71]	1.39 [0.94,2.05]*	0.96	2.63 [1.45,4.77]**	2.05 [1.31,3.21]**	0.13
Condom use						
Ref=no current use						
Used with at least one partner	1.57 [0.85,2.88]	2.49 [1.55,3.98]**	0.21	2.48 [1.34,4.58]**	2.88 [1.43,5.79]**	0.97
Consistency of Condom use†						
Inconsistent use						
Consistent use with all partners	0.41 [0.16,1.05]*	0.40 [0.24,0.67]**	0.41	0.82 [0.39,2.03]	0.56 [0.29,1.08]*	0.51

Notes: Figures reported in the table are Odds ratios derived from logistic regression models, adjusting for age and marital status.
†*P*-values reported in these columns are derived from tests of the null hypothesis that the odds ratios of SR-SP vs. SR-MCP and SR-SP vs. NR-MCP are equal. Low p-values indicate that the null hypothesis is rejected.
[a] No men with NR-MCP interviewed during the sexual network survey indicated having recently sought treatment for STI.
** $p < 0.05$, * $p < 0.1$.

Table 3: Estimated proportion of incident HIV infections resulting from concurrent partnerships as a function of HIV transmission probabilities within marital and non-marital partnerships, according to self-reported and network data.

P^m / P^{nm}	β	Self-reported data	Network data	Bias
1	0.01	22.4%	35.9%	56.4%
2	0.01	21.4%	33.7%	57.4%
10	0.01	20.3%	32.2%	58.4%
0.5	0.01	23.8%	36.9%	54.8%
0.1	0.01	26.7%	40.3%	50.6%
1	0.05	22.5%	35.2%	56.5%
2	0.05	21.4%	33.8%	57.5%
10	0.05	20.4%	32.2%	58.3%
0.5	0.05	24.2%	37.2%	53.9%
0.1	0.05	27.2%	40.6%	49.3%

Notes: The estimates presented are proportions derived from model 1 using data from the Likoma Network Study

et al. 2005), men misclassified by self-reported data may thus also be more infectious than the rest of the population. Men who did not disclose ongoing concurrent sexual relationships during the sexual network survey were also much less likely to have consistently used condoms with their partners, but were significantly less likely to be infected with HIV. Our study thus indicates that the concurrent relationships omitted during sexual behavior surveys based on self-reported data may be more likely to present high risks of HIV transmission. Population-based studies of the factors determining HIV spread (e.g., Boerma et al. 2003; Lagarde et al. 2001) may thus have largely under-estimated the contribution of partnership concurrency to local epidemics. These findings may strengthen the claim that concurrent partnerships are the "key driver" of generalized HIV epidemics. They are also important in light of the renewed emphasis on HIV interventions promoting partnership reduction (Potts et al. 2008; Shelton 2007): while self-reported data on MCP would identify the behaviors of men as the main "culprit" in establishing generalized HIV epidemics, MCP are also common among women in particular at younger ages. While the few existing examples of partner reduction programs such as Uganda's "zero grazing" (e.g., Stoneburner and Low-Beer 2004) had a strong gender bias, partner-reported network data suggests that such interventions should be more broadly targeted and aim at addressing the concurrent relationships of women as well.

Our study suffers from several limitations. First, while the true impact of concurrency is measured among partners' of an index case (Morris 2001), we were not able to directly assess the impact of partnership concurrency on the *transmission* of HIV. Instead, we were only able to show that factors favoring HIV transmission were more common in MCP that were omitted by self-reported data. This limitation stems from the fact that our sample size is small, that our data are cross-sectional and the biomarkers of HIV infection we used were limited to the detection of HIV antibodies (and thus did not allow identifying recent acute HIV infection). Studies having estimated precisely the impact of concurrency on the transmission of a pathogen in a population were either based on prospective research designs (Potterat et al. 1999) or were able to classify connected cases of a disease by stage of infection (Koumans et al. 2001).

Second, network data improves on estimates of sexual behavior parameters derived from self-reported data only insofar as the partners of respondents are also enrolled in the study. The reduction in bias afforded by partner-reported data thus varies with levels of(*i*) survey non-response among members of the study villages, and (*ii*) sexual mixing with partners residing outside of the study area. Non-response was limited for the sexual network survey as only 11% of eligible participants declined to be interviewed or were absent at the time we visited them. Sexual relationships with partners residing outside of the study villages were on the other hand much more common and presented significant HIV risks Helleringer and Kohler (2007). If inhabitants of the sampled villages were more likely to under-report partnerships they engaged in with residents of the mainland or of other villages of Likoma, then our estimates of the prevalence of MCP in this population may still be biased downwards.

Third, our results based on partner-reported data may also be affected by over-reporting of sexual relationships. Indeed, several studies have argued that some respondents (especially younger men) could "swagger" during surveys and exaggerate the number of partnerships they were involved in (Mensch et al. 2003; Nnko et al. 2004). Other studies have pointed out that women may exaggerate the duration of their relationships and may report particular relationships as ongoing even though the man considers their relationship as over (Nnko et al. 2004). Such patterns of sexual behavior reporting could lead to over-estimating concurrency levels among inhabitants of Likoma.

There are however several strong indications that these biases do not affect our data. While it is easy to swagger when asked about the number of sexual partners one has had, it is much more complicated to do so when asked to name (and provide locating information about) these partners. On the other hand, women misclassified by self-reported data were also more than twice more likely to present symptoms of STIs than women in serial relations. suggesting that they may indeed have taken more sexual risks than their reports of sexual partnerships suggest. Similarly, only in 27 relationships did partners disagree on whether or not the partnership was still ongoing at the time of the survey. In 14 of these relationships, the man reported that the relationship was still ongoing. When these relations were excluded from the analyzes, estimates of MCP prevalence based on linked records declined only slightly and the correlates of concurrency described in table 2 remained unchanged. Finally, of 31 extra-marital relationships between a man and a married woman reported during this study, 23 (74.2%) were reported jointly by both partners. On the other hand, among the 59 non-marital relationships between a man and a never married woman, only 20 (33.4%) were reported jointly by both partners. The difference in proportions was significant at the .05 level, indicating that younger (unmarried) women may be more likely to be secretive about their relationships than younger men to be "swaggering" about theirs (Nnko et al. 2004).

Our model of HIV transmission (equation 1) does not capture the total effects of partnership concurrency on HIV spread within a population. Indeed, these effects do not depend solely on the overlap between sexual relationships but also on the duration of this overlap. While we assumed that the distribution of HIV within sexual networks was approximately constant over short time intervals, the main effect of partnership concurrency is to diffuse (and thus alter the distribution) within the population. Estimates of the contribution of partnership concurrency to HIV spread derived from dynamic stochastic simulations thus often find a significantly higher proportion of incident infections attributable to MCP (e.g., Morris and Kretzschmar 1997). This is in addition compounded by the interaction between partnership concurrency and the course of HIV infectivity (Wawer et al. 2005).

In brief, the findings presented here indicate that the role of MCP in the diffusion of HIV within sub-Saharan populations may have been underestimated in comparative studies of the determinants of HIV risks. Self-reported data are not well-suited to estimate the prevalence of MCP in local populations and assess the contribution of partnership concurrency to the uneven spread of HIV. The design and evaluation of behavioral interventions targeting partnership concurrency should rely on sexual network data, that includes partner tracing.

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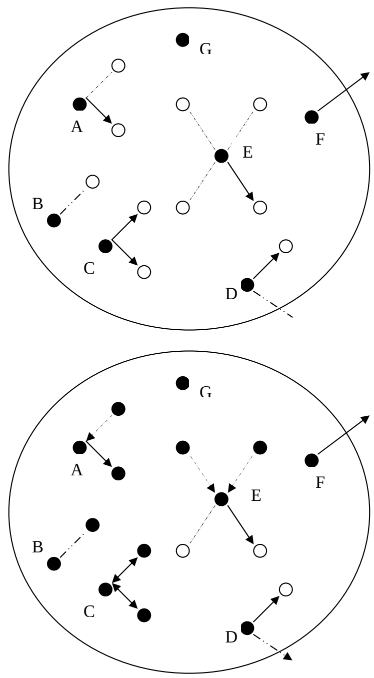

Figure 1: Comparison of self-reported sexual behavior data and partner-reported network data.
In panel A, individuals A,B,C,D,E,F,G are sampled from the population and are asked to report their sexual relationships.
In panel B, the same individuals are interviewed as are their partners as part of the complete network survey. In panel B, if individual A does not disclose his/her relationship with any of his/her partner, A may still be classified as involved in a concurrent partnership if the partner(s) report this relationship.
Solid black circles represent individuals interviewed during a survey. Solid arrows represent the nominations made by a respondent during a sexual behavior survey. Dotted lines represent relationships of a respondent that he/she did not disclose during the sexual behavior survey. We consider that a sexual relationship took place between two respondents as long as at least one of the two partners reported it during the survey

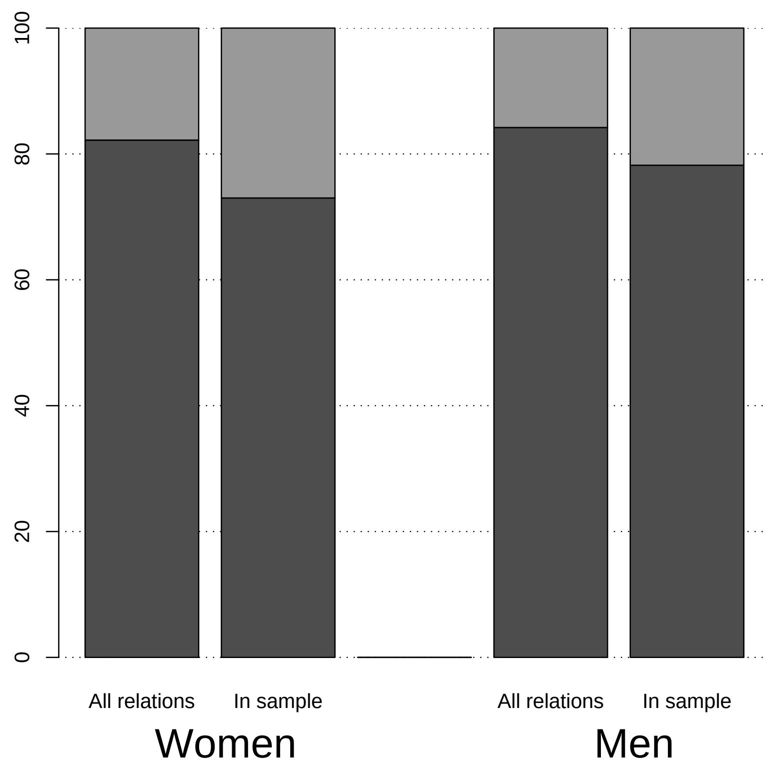

Figure 2: Proportion of sexual partnerships reported by respondents and their partners.