Concurrent Sexual Partnerships and HIV Infection in sub-Saharan Africa: Evidence from Recent Population-Based Surveys

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SHORT ABSTRACT

In 2006, the Joint United Nations Programme on HIV/AIDS and the Southern African Development Community indicated that high rates of concurrent sexual partnerships, combined with low rates of male circumcision and infrequent condom use, are major drivers of the AIDS epidemic in southern Africa. Nonetheless, a heated controversy remains about the strength of this association, in mathematical models as well as empirical analyses existing data. We take advantage of the most recent self-reported data on sexual partnerships and HIV biomarker data collected by the Demographic and Health Surveys (DHS) to evaluate and compare the prevalence of concurrent sexual partnerships across countries in sub-Saharan Africa— defining concurrent partnerships as having two or more sexual partners that overlapped in time in the year preceding the survey. We also examine key characteristics of respondents reporting concurrent partnerships in pooled samples for sub-Saharan Africa, and we evaluate the correlates of concurrency and HIV serostatus at the individual and aggregate level.

LONG ABSTRACT

Introduction

The main goal of this study is to evaluate and compare the prevalence of concurrent sexual partnerships (or sexual concurrency) across all countries in sub-Saharan Africa with available data, as well as the association between sexual concurrency and HIV. In recent years, new data on self-reported sexual partnerships as well as HIV serostatus from biomarker testing have been collected from adult women and men in about two dozens nationally representative Demographic and Health Surveys (DHS) and AIDS Indicator Surveys (AIS). These data provide a unique opportunity to measure the prevalence of concurrent sexual partnerships, and to assess the relationship between sexual concurrency and HIV infection.

Using information that the surveys collected on up to three of the respondents' most recent sexual partners (including their extra-marital sexual relationships), we define concurrent partnerships as having two or more sexual partners that overlapped in time. We compare respondents with concurrent sexual partners to those who have not had multiple partners during their lifetime, and to those who had multiple but not concurrent partners in the 12 months preceding the survey. We also examine the characteristics of respondents reporting concurrent partnerships in a pooled sample for all sub-Saharan African countries with available data to assess whether urban, more educated, and wealthier respondents are more likely to have concurrent partnerships, and whether respondents who have concurrent partners are more likely to use condoms than respondents who do not have concurrent partners. Finally, we evaluate the association between sexual concurrency and HIV serostatus at the individual level, after controlling for educational level, wealth status, condom use, male circumcision, and other factors, and we assess the relationship between prevalence of concurrency and HIV prevalence at the community and country levels.

Data

This study uses data from 22 nationally representative surveys of adult women and men (age 15-49[1]) that were carried out between 2006 and 2012 in sub-Saharan Africa. Twenty of these are DHS surveys, in Burkina Faso, Cameroon, Congo Brazzaville, Ethiopia, Gabon, Guinea, Kenya, Lesotho, Liberia, Malawi, Mali, Niger, Rwanda, Senegal, Sierra Leone, Swaziland, Tanzania, Uganda, Zambia, and Zimbabwe. The remaining two are AIS surveys, in Côte d'Ivoire and Mozambique.

The present analysis uses the DHS/AIS surveys indicated above because they included HIV testing for all interviewed respondents who consented[2], as well as new survey data on self-reported sexual partnerships (described in more detail below) and other

[1] In most countries the DHS/AIS surveys interview men aged up to age 54 or 59. Yet this analysis focuses on women and men age 15-49 in all countries to ensure results' comparability.
[2] DHS/AIS respondents provided separate informed consent for the survey interview and for HIV testing.

demographic, behavioral and social indicators. Survey interviews are conducted in privacy after establishing the rapport with the respondent and after obtaining informed consent. Sexual behavior questions are asked after a long set of questions related to the respondent's background, reproduction, contraception, pregnancy and delivery care, immunization, child health, and nutrition.

Testing for HIV is conducted using standard blood collection, testing, and quality-control procedures (Macro International 2007a, 2007b). Specifically, HIV testing is done using two HIV enzyme immunosorbent assays (EIA), based on different antigens. Specimens with equivocal or discordant test results are resolved by Western Blot testing. For quality control, all HIV-positive specimens and a sample of HIV-negative specimens (usually 5 percent) are re-tested at a different laboratory using the same testing algorithm. HIV test results for individual respondents are linked anonymously to the information gathered in the household and individual survey questionnaires using bar codes.[3] Protocols for the HIV testing and survey interview are cleared by the Institutional Review Boards of Macro International and approved by the local governments and implementing partners. Further details on survey design and implementation are provided in the individual country reports.

The DHS/AIS individual survey questionnaire collects information on the respondents' sexual histories in a specific section of the questionnaire. This section has undergone key changes after 2006 that make it appropriate for studying sexual concurrency. Indeed, based on the results of earlier work (Mishra and Bignami-Van Assche, 2009), we made key recommendations to modify the DHS/AIS core questionnaire in order to better measure sexual behavior and sexual concurrency, which began being implemented in the Phase V of the DHS program. The standard DHS/AIS core questionnaire now asks respondents the number of sexual partners they had in the 12 months preceding the survey, and for up to three of their most recent sexual partners in the previous 12 months they also ask about:

- when was the last time (in terms of days, months, or years before the survey) that the respondent had sexual intercourse with each sexual partner;
- whether a condom was used the last time the respondent had sexual intercourse with each partner;
- whether a condom was used every time the respondent had sexual intercourse with each of his/her three most recent partners during the previous 12 months;
- the type of relationship the respondent had with each sexual partner (spouse or live-in partner, acquaintance, commercial sex worker);
- when was the first time (in terms of days, months, or years before the survey) that the respondent had sexual intercourse with each sexual partner, including spousal partners;
- how many times during the previous 12 months the respondent had sexual intercourse with each partner (once, twice or more).

The core DHS questionnaire now also includes a question about the total number of sexual partners that the respondent had in his/her lifetime.

[3] In the 2006 Benin DHS, HIV testing was included but bar code links were destroyed following the preparation of the main survey report. Thus it is not possible to link individual HIV test results with survey information from the available data, and thus survey had to be excluded from the present analysis.

The most important change compared to earlier surveys is that the question on the duration of the sexual relationship with each of the respondent's three most recent sexual partners is asked for spousal as well as non-spousal partners. This is important because, for respondents married at the time of the survey who have been married more than once, DHS/AIS surveys do not collect information on the duration in the current union, but only on the duration since the start of the respondent's *first* union (whether continuing or not). Nonetheless, for men in polygynous unions (having more than one spouse) the DHS/AIS surveys still do not collect information about the marriage date for each of the respondent's spouses. In light of this limitation of the data, for the purposes of the analysis we make specific assumptions about this group of respondents (as illustrated in detail in the next section).

Measurement of Concurrent Sexual Partnerships

In this study, concurrent sexual partnerships are defined as having more than two partners that overlapped in time.

To identify concurrent partnerships, we use two main pieces of information from the DHS/AIS sexual histories:

- the duration elapsed from the respondent's last sexual encounter with partner *i* (*i*=1, 2, 3) to the survey date (henceforth e_i), expressed in days, weeks, months, or years;

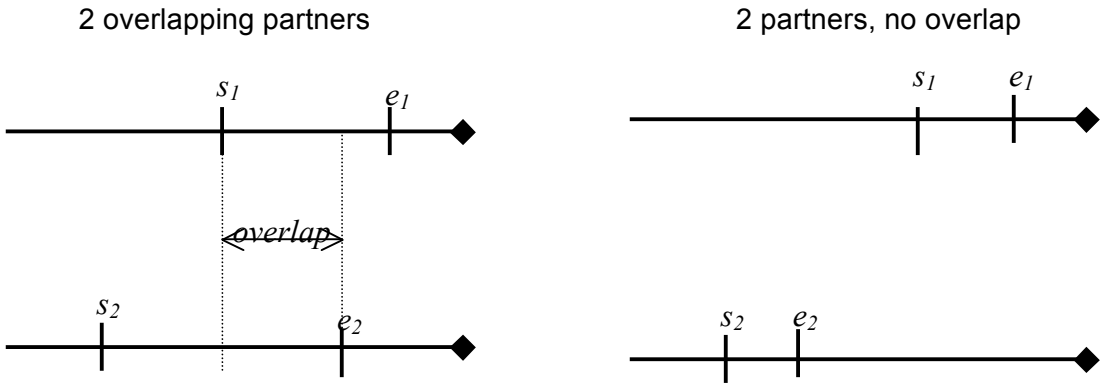
- the time elapsed from the beginning of the sexual relationship with partner *i* to the survey date (henceforth s_i), expressed in days, weeks, months, or years.

To identify overlapping partners we proceed as follows:

- Respondents who reported two sexual partners in the 12 months preceding the survey: the overlap between the last and next-to-last sexual partner (henceforth o_{12}) occurs if $s_1 > e_2$.
- Respondents who reported three or more sexual partners in the 12 months preceding the survey:
    - the overlap between the last and next-to-last sexual partner (o_{12}) occurs if $s_1 > e_2$;
    - the overlap between the last and second-to-last sexual partner (o_{13}) occurs if $s_1 > e_3$; and
    - the overlap between the next-to-last and second-to-last sexual partner (o_{23}) occurs if $s_2 > e_3$.[4]

[4] Theoretically, the condition $e_3 > e_2 > e_1$ should always be satisfied since questions on the last sexual partnership should have been asked before the questions on the next-to-last partnership. However, in some surveys a few cases violated this condition and were thus recoded as missing.

For example, in the simple case of two partners:



We then calculate the duration of overlapping partnerships as follows:

- Between the last and next-to-last sexual partner (od_{12}):
  $od_{12} = s_1 - e_2$ if $s_2 > s_1$
  $od_{12} = s_2 - e_2$ if $s_2 < s_1$
- Between the last and second-to-last sexual partner (od_{13}):
  $od_{13} = s_1 – e_3$ if $s_3 > s_1$
  $od_{13} = s_3 – e_3$ if $s_3 < s_1$
- Between the next-to-last and second-to-last sexual partner (od_{23}):
  $od_{23} = s_2 – e_3$ if $s_3 > s_2$
  $od_{23} = s_3 – e_3$ if $s_3 < s_2$

Since information on the duration of the current relationship is not available for male respondents in a polygynous union, we assume that if the respondent had two or more partners in the previous 12 months, he had engaged in concurrent partnerships over the same time period.

Analytical Approach

Our analysis is divided into three parts. In the first part, we assess the prevalence of multiple sexual partnerships. We evaluate the prevalence of multiple sexual partnerships across countries by focusing on two indicators: the number of partners the respondent reports to have had in the 12 months preceding the survey (recent multiple partnerships); and the number of partners the respondent reports to have had during his/her lifetime (lifetime multiple partnerships).

In the second part of the analysis, we assess the prevalence of concurrent sexual partnerships across countries by combining information on number of lifetime partners and on overlapping partnerships in the past 12 months. We group all respondents who ever had sex into the following three exclusive categories: (i) had only one lifetime sexual partner; (ii) had two or more lifetime partners, but no overlapping partners in the past 12 months; and (iii) had two or more overlapping partners in the past 12 months. This three-category indicator is the primary variable of interest in our study, which permits us to distinguish respondents who did not have multiple partners in their lifetime

from those who had multiple partners in their lifetime but not recent concurrent partnerships, and those who had recent multiple concurrent partners. We also appraise whether the prevalence of concurrency varies according to the duration of the overlapping sexual partnerships. Finally, for the pooled sample of all sub-Saharan African countries in the analysis, we evaluate the correlates of sexual concurrency, including age, education, marital status, urban/rural residence, household wealth status, male circumcision, and condom use.In the third part of the analysis, we examine the association between sexual concurrency and HIV at different levels of aggregation: the individual, the community, and the country as a whole.

At the individual level, we assess the relationship between concurrent sexual partnerships in the previous 12 months and HIV serostatus at the time of the survey; we assess this relationship by duration of overlap as well. Using the pooled sub-Saharan Africa sample, we also conduct multivariate analyses to examine the associations between concurrency and HIV status, after controlling for potential confounders such as age, education, and wealth status.[5]

To examine if living in a community with higher prevalence of concurrency is associated with higher prevalence of HIV, separately for women and men in each country, we calculate the proportion of respondents reporting two more overlapping partners in the past 12 months in each survey cluster (usually a village or an urban block). We then group together all clusters in a survey according to five levels of prevalence of concurrency (none, less than 5 percent, 5-10 percent, 10-15 percent, 15 percent or more), and we compute the proportion of respondents testing positive for HIV in each group of clusters. To examine the association between concurrency for one sex and prevalence of HIV among individuals of the opposite sex, we repeat the same procedure but cross-tabulate HIV prevalence among women by the prevalence of concurrency among men, and HIV prevalence among men by the prevalence of concurrency among women.

Finally, we examine the association between the prevalence of sexual concurrency and the prevalence of HIV using aggregated country-level data, separately for women and men, as well as by cross-correlating HIV prevalence among women by concurrency prevalence among men and vice versa.

Data are analyzed using both descriptive and multivariate statistical methods. All analyses are carried out using STATA 12.0, incorporating sampling weights and accounting for clustering in the survey design. All analyses are carried out separately for women and men, as well as for the combined samples (women and men).

Study Limitations

The first main limitation of this study is that our analysis is based on self-reported data about sexual behaviors, which are known to be prone to measurement bias (Plummer et al. 2004). Women tend to underreport and men tend to exaggerate their premarital and extramarital sexual activity (Zaba et al. 2004). In a given social context, the extent of such misreporting could vary by sex, educational level, economic status, and area of

[5] The multivariate models are not carried out for individual countries because in most cases the number of respondents with overlapping partners is too small to allow for multivariate analyses.

residence (Hewett et al. 2004). Not surprisingly, some epidemiological studies in Africa have observed weak associations between self-reported risky sexual behavior and HIV status (Ferry et al. 2001). An evaluation of self-reported data in a large multicenter study on factors determining the differential spread of HIV in four African cities found considerable numbers of HIV-positive women who reported themselves to be virgins or having had only one sexual partner and few episodes of sexual intercourse, suggesting evidence of underreporting of sexual behavior (Buvé et al. 2001). Although sexual behavior is often believed to be underreported in the DHS surveys, a comparison with the multicenter study revealed greater reporting of higher-risk sex in the DHS surveys than in all four cities in the multicenter study (Buvé et al. 2001). Nevertheless, the findings of our study may be biased to the extent men and women misreport their number of sexual partners, sex with non-regular partners, condom use, and other related behaviors (Mensch et al. 2003), and to the extent that the degree of misreporting varies across regions or other population subgroups.

Another important limitation is that the analysis is based on cross-sectional data. It is therefore difficult to assess causality between sexual concurrency and HIV infection because, for many HIV-positive adults, the infection may have preceded their sexual and other behaviors recorded in the survey. Therefore, it is possible that sexual concurrency in the recent past does not correlate well with HIV serostatus at the time of survey. Moreover, the strength of the relationship between concurrency and HIV infection is likely to change over time, depending on the stage and spread of the epidemic. Although cross-sectional data do not allow examining this relationship at different stages of the epidemic in a population, our analysis does include surveys from countries with varying levels of HIV prevalence.

Third, the surveys used for the analysis did not collect information on complete sexual histories. Some overlapping partnerships may have thus been missed because the surveys only covered up to three of the respondent's sexual partners in the previous year; while some respondents (mostly men) reported having had more than three partners in the same period. Many more concurrent partnerships may have been missed because there is no information on concurrent partnerships that ended more than 12 months before the survey.

Fourth, our measurement of concurrency may be biased to the extent it assumes regular sexual activity with each sexual partner during the overlapping period. This assumption was necessary because the surveys collected no information about the respondents' frequency of intercourse with their sexual partners. However, for a concurrent relationship to substantially increase the transmission risk of HIV, the sexual intercourse between the concurrent partners needs to occur within a short window of about three weeks (the high infectivity period following infection).

Finally, the surveys used for the analysis did not collect data on sexual networks, which have been shown to increase the risk of HIV infection by allowing the virus to spread rapidly to others (Morris and Kretzschmar 1997; Kohler and Helleringer 2006). Our data thus do not allow examining the behaviors of one's sexual partner(s), which could be important in assessing one's own risk of HIV infection. However, we attempt to address this limitation by using aggregated data at the community level and at the country level to examine the associations between the prevalence of HIV among women and the prevalence of concurrency among men, as well as the association between the prevalence of HIV among men and the prevalence of concurrency among women.

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