

Correlates of concurrency among young people in Carletonville, South Africa

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Abstract

There is still a considerable debate about whether socioeconomic or cultural factors underpin the high prevalence of sexual partner concurrency in parts of Southern and Eastern Africa. We analyzed the patterning and correlates of concurrency in a population-based sample of 1182 sexually active 14–24 year olds in Carletonville, South Africa. Potential demographic, socioeconomic and attitudinal risk factors were assessed via a questionnaire. The association between risk factors and respondent reported concurrency were assessed using multivariate logistic regression. Separate models were run for men and women. Point-concurrency rates at the time of the survey and 6 months prior to the survey were similarly high – 19.3 (95% confidence interval, CI 14.2–18.5%) and 16.2% (CI 14.1–18.4%), respectively. Multivariate logistic regression revealed that for men and women, concurrency was not associated with socioeconomic deprivation but was associated with a number of sexual partners, being married and having a partner who was thought to have an additional partner. Female concurrents were more likely to use alcohol, have an older partner and have difficulties negotiating condom usage and refusing sex with their partners. Male concurrents were less likely to use a condom regularly and less likely to wear a condom when their partner asked them to. The strong relationship between respondent and partner concurrency appears to depend on contemporary concurrency, as opposed to the behavior of previous partners. If high concurrency rates are in part driven by positive feedback loops of partner and respondent concurrency, then norm change involving the rejection of concurrents could be self-amplifying leading to a rapid decline of concurrency.

Keywords: socioeconomic, culture, life-course, HIV

Résumé

Il y a encore de nombreux débats pour savoir si des facteurs socio-économiques ou culturels sont à la base de la forte prévalence de simultanéité de partenaires sexuels dans certaines parties de l'Afrique Australe et de l'Afrique de l'Est. Nous avons analysé la structuration et les corrélations de la simultanéité dans un échantillon de la population, c.-à-d. chez 1182 personnes sexuellement actives, âgées de 14–24 ans, à Carletonville, en Afrique du Sud. Les facteurs de risque potentiels au niveau démographique, socio-économique et comportemental ont été évalués au moyen d'un questionnaire. L'association entre les facteurs de risque et la simultanéité rapportée par les répondants a été évaluée par le moyen d'une régression logistique multivariée. Des modèles séparés ont été utilisés pour les hommes et les femmes. Les taux de simultanéité au moment de l'enquête et 6 mois avant l'enquête étaient tout aussi élevés – respectivement 19,3 (95% Intervalle de Confiance – CI de 14,2 à 18,5%) et 16,2% (de 14,1 à 18,4% CI). La régression logistique multivariée a montré que pour les hommes et les femmes la simultanéité n'était pas associée à la privation socio-économique mais était associée au nombre de partenaires sexuels, étant mariés et ayant un partenaire qui était supposé avoir un partenaire additionnel. Les concurrents du sexe féminin étaient plus enclins à consommer de l'alcool, à avoir un partenaire plus âgé et à avoir des difficultés à négocier l'utilisation du préservatif et de refuser des rapports sexuels avec leurs partenaires. Les concurrents de sexe masculin étaient moins enclins à utiliser régulièrement un préservatif et à porter un préservatif lorsque leur partenaire le leur demandait. La forte relation entre la simultanéité du répondant et du partenaire semble dépendre de la simultanéité contemporaine, par opposition au comportement de partenaires précédents. Si les taux de simultanéité élevés sont en partie conduits par des boucles de rétroaction positive de la simultanéité du partenaire et du

résident, alors le changement de norme impliquant le rejet de concurrents pourrait être auto-amplifiant, conduisant à une baisse rapide de la simultanéité.

Mots-clés: Socio-économique, culturelle, durée de la vie, le VIH

Although there is still a considerable debate on this topic, high sexual partner concurrency rates in Southern and Eastern Africa are believed by many to be a key factor underpinning the generalized HIV epidemic in this region (Halperin, Mugurungi, Hallett, Muchini, Campbell, Magure, *et al.* 2011; Kenyon & Colebunders 2012; Mah & Halperin 2010; Morris, Epstein & Wawer 2010). Concurrency is defined as having two or more relationships active at the same time. Differential concurrency rates may also be part of the reason for the striking racial differentials in HIV prevalence in South Africa (Kenyon, Buyze & Colebunders 2013; Kenyon, Dlamini, Boule, White & Badri 2009). Dealing with concurrency requires understanding what is driving the high concurrency rates in the region. The underlying determinants remain hotly debated (Mah *et al.* 2010). A number of papers, relying predominantly on qualitative evidence, have argued for the primacy of socioeconomic factors (Hunter 2007; Kaufman & Stavrou 2004; Leclerc-Madlala 2004; Selikow, Zulu & Cedras 2002). Hunter (2007), for example, argued that a combination of three factors is responsible; rising unemployment, reduced marital rates and high level of women's migration.

Other studies that have tried to unpack this issue using a quantitative approach have found that concurrency is not patterned in a way that suggests that socioeconomic factors are dominant determinants (Kenyon, Boule, Badri, Asselman 2010; Xu, Luke & Msiyaphazi Zulu 2010). This has led to the argument that cultural factors are at least as important as socioeconomic factors (Kenyon *et al.* 2010). This study aims to determine the factors associated with the concurrency in young urban South Africans.

Methodology

The Carletonville Youth Survey (CYS) consisted of a representative sample of 723 men and 784 women between the ages of 14–24 living in a township in the gold mining town of Carletonville. The sampling technique was designed in such a way that it was self-weighting. Households were selected via a two-stage random sampling technique. Index houses were selected randomly from a map of the area. All men and women aged 14–24 years, who slept in the selected houses on the night before the survey visit were eligible for participation in the study. It was conducted in August 1999. The occupants of 89% of the selected houses were located and 11.3% of potential participants declined to participate. Eligible participants were taken to a local health facility where the interview was conducted in private. Interviewers filled in the questionnaires during the private interview. This was done in the language of the participant. The questionnaire was adapted from a UNAIDS questionnaire. Participants were questioned about background characteristics as well as sexual partnerships firstly with marriage partners and then in detail about their last five non-marital sexual

partners. In line with UNAIDS recommendations, we measured the prevalence of point concurrency at the time of the survey and 6 months prior to the survey as well as the prevalence of cumulative concurrency (UNAIDS 2010). A 6-month point-concurrency was defined as having two or more sexual relationships active 6 months prior to the survey. Concurrency here was derived from two sexual diary questions: when the respondent had sex with the partner for the first time and how long the relationship lasted. If at least two relationships were active 6 months prior to the interview, they were coded as concurrents. The dependent variable used in the analysis was point respondent concurrency at the time of the survey. This was defined as the respondent having two or more sexual relationships active at the time of the survey. This variable was derived from a question directed at each of the last five non-marital relationships asking if it was active at the time of the interview. If two or more relationships were active at the time of the survey, the respondent was categorized as concurrent. In addition, we assessed if the respondent had ever had a concurrent relationship – where the dates of two relationships overlapped. The independent variables assessed for inclusion into model A consisted of a range of socio-demographic, individual and relationship characteristics that have been shown in other studies to affect concurrency (Adimora, Schoenbach & Doherty 2007; Adimora, Schoenbach, Taylor, Khan & Schwartz 2011; Carter, Kraft, Koppenhaver, Galavotti, Roels, Kilmarx, *et al.* 2007; Kenyon *et al.* 2010; Mah 2010; Maughan-Brown, Kenyon & Lurie 2014; Mishra & Van Assche 2009; Sandøy, Dzekedzeke & Fylkesnes 2010; Steffenson, Pettifor, Seage, Rees & Cleary 2011; Xu *et al.* 2010). The respondents' individual income was categorized into one of the three categories: monthly income <R50, R50–R200 or >R200. This was based on respondents' self-reported monthly monetary income.

Relationships characterized by excessive male power have been shown to be associated with increased risk of HIV acquisition by the female partner in South Africa (Jewkes, Dunkle, Nduna & Shai 2010). Excessive male power is postulated to be associated with a conception of a hegemonic-masculinity that seeks to control women and justifies men's multiple partnering (Jewkes *et al.* 2010). To investigate if concurrency may mediate part of the relationship between power-imbalance and HIV acquisition, we included one variable which measured respondents attitudes to their partner's sexual health preferences (condom use) and two which assessed how much power respondents felt they had to refuse sex and insist on using a condom. To investigate the strong relationship found between respondent and partner concurrency, we ran additional models that disaggregated partner concurrency into previous and present partner concurrency. In model B, the partner concurrency variable was disaggregated into four parts to assess which aspects of partner concurrency

were associated with respondent concurrency. The reference group (P0) comprised respondents who thought that none of their past or current partners had engaged in concurrency. Group P1 was defined as respondents in whom only previous partners had engaged in concurrency. Group P2 was defined as those as having one current partner who was thought to have other partner(s). Group P3 was defined as those as having two or more current partners who were thought to have other partner(s). In model C, we assessed the impact of one's first non-marital partner having engaged in concurrency on respondent concurrency. The model was identical to model A except that it used a different measure of partner concurrency. Partner concurrency was represented by a dichotomous variable based on if the respondent's first partner had an additional partner or not.

We used 95% confidence interval (CI) of the odds ratio (OR) and Chi-squared tests to investigate the statistical significance of the association between concurrency and the putative risk factors. All risk factors associated with concurrency at a significance level of 0.1 or less were entered into a backward stepwise selection, multiple logistic regression model. Because a number of studies have shown that the relationship between concurrency and potential risk factors varies by gender, the models were stratified by gender (Kenyon *et al.* 2010; Mah 2010).

The analysis presented here is restricted to the 1182 individuals who were sexually experienced. For a more detailed description of the survey methodology, see Auvert *et al.* (2001). The analysis was performed using STATA 10 software (Stata, East College Station, TX). Respondents provided informed written consent to participate in the survey. Ethical approval for the study, including the consent process, was obtained from the Research on Human Subjects committee of the University of the Witwatersrand (Protocol number M 970235). All participants provided written informed consent.

Results

The sample was relatively evenly split between males (723) and females (784). Four ethnic groups (Tswana, Sotho, isiXhosa, and isiZulu) constituted the majority (94.7%) of the population (Table 1). The median age was 18 years for men (IQR (Interquartile Range), 16–21 years) and 19 years for women (IQR, 16–21 years). The majority of the population were students (27.1% of men and 46.7% of women) or unemployed (59.9% of men and 44.6% of women). The median age of sexual debut was 16.6 years for men (IQR, 15.2–18.2), and 17.2 years for women (IQR, 16.0–18.5 years). The median (mean) number of lifetime sexual partners was 3 (4.7) for men and 2 (2.6) for women. A total of 16.1% (CI 14.2–18.5%) of respondents reported having two or more sexual partners at the time of the interview.

Point-concurrency rates were considerably higher in men (21.4%, CI 18.3–25.2%) than women (11.5%, CI 9.1–14.2%). The prevalence of concurrency 6 months prior to the survey was 16.2%, CI 14.1–18.4%. About 40.9% (CI 35.2–43.7%) of respondents had engaged in concurrency at some stage in their past. The proportion of respondents who thought that their most recent or any partner had had another sexual partner at the time of their

relationship was 28.1% (CI 25.6–30.8%) and 63.2% (CI 59.8–65.2%), respectively.

Table 2 depicts the results of the multiple logistic regressions, by sex. In both men and women, concurrency was correlated with increasing numbers of lifetime sexual partners, living in an informal housing settlement, being married (or living as a married couple) and believing that one of the respondent's current partners had another sexual partner. In addition, women who had a partner who was 5 or more years older and women who consumed alcohol at least once a month were more likely to report concurrency. Men who did not always use a condom with their last five partners and men who defined their ethnicity as isiZulu were also more likely to report concurrency in a relationship. Several attitudinal variables were found to correlate with concurrency. Men who said they would agree to use a condom if their partner asked them to, reported lower concurrency than men who said they would not agree. Women who said that they would refuse to have sex with someone who refused to use a condom, and women who said that they were confident that they would be able to refuse sex, if they did not desire it, both reported lower concurrency rates.

A number of variables did not achieve significance in earlier models to warrant their inclusion in the final models. These included religion, membership of a wide range of clubs and organizations, educational outcomes in men, occupation in women, payment/receipt of payment for sex, forced sex, knowledge of HIV and prevention thereof.

In Model B (not shown), the partner concurrency variable was disaggregated into four parts to assess which aspects of partner concurrency were associated with respondent concurrency. Individuals in P1 (respondents in whom only previous partners had engaged in concurrency) reported a lower prevalence of concurrency than the reference group P0, who thought that none of their past or current partners had engaged in concurrency (OR 0.2 (CI 0.1–0.5) for men and women). Those in P2 (those who thought that one current partner had another partner) and P3 (those who had two or more current partners who were thought to have other partners) reported considerably higher concurrency rates than P0. The ORs for P2 compared to P0 were 7.0 (CI 2.8–17.7) for men and 4.0 (CI 1.6–10.3) for women. There was no evidence of a dose–response relationship—individuals in P3 and P2 reported similar rates of concurrency. The ORs for P3 compared to P0 were 3.6 (CI 1.8–7.2) for men and 2.9 (CI 1.1–7.1) for women. Model B as a whole had a better fit to the data than model A.

Model C (not shown) assessed the impact of one's first non-marital partner having engaged in concurrency on respondent concurrency. In this model, partner concurrency was represented by a dichotomous variable based on if the respondent's first partner had an additional partner or not. First partner concurrency was associated with a reduction in respondent concurrency (ORs 0.5 (CI 0.3–0.9) for men and 0.2 (CI 0.1–0.5) for women). Various tests indicated that the models exhibited a good fit to the data and that collinearity among the variables was not present.

Table 1. Percentage distribution of sexually active respondents for selected characteristics.

| | Men | Women |
|---------------------------------|------------|------------|
| | n (%) | n (%) |
| Age | | |
| 14–16 years | 99 (17.7) | 86 (13.8) |
| 17–18 years | 143 (25.5) | 123 (19.8) |
| 19–21 years | 178 (31.8) | 226 (36.3) |
| 22–24 years | 140 (25) | 187 (30.1) |
| Marital status | | |
| Married or living as married | 31 (5.5) | 108 (17.4) |
| Never married | 529 (94.5) | 513 (82.6) |
| Living in squatter settlement | | |
| Yes | 156 (27.9) | 251 (40.4) |
| No | 404 (72.1) | 371 (59.7) |
| Migrant worker | | |
| Yes | 47 (8.4) | 45 (7.2) |
| No | 509 (91.6) | 568 (92.8) |
| Education completed | | |
| None | 23 (4) | 25 (4) |
| Primary | 131 (23) | 153 (25) |
| Secondary | 378 (68) | 409 (66) |
| Post matric | 28 (5) | 35 (6) |
| Monthly income | | |
| <R50 | 267 (47.7) | 260 (41.8) |
| R50–R200 | 181 (32.3) | 248 (39.8) |
| >R200 | 112 (20.0) | 114 (18.3) |
| Occupation | | |
| Trader | 27 (4.8) | 33 (5.3) |
| Student | 151 (27.1) | 290 (46.7) |
| Unemployed | 334 (59.9) | 277 (44.6) |
| Other employment | 46 (8.2) | 21 (3.4) |
| Ethnic group | | |
| Tswana | 234 (42.0) | 221 (35.9) |
| Zulu | 47 (8.4) | 42 (6.8) |
| Xhosa | 158 (28.6) | 193 (31.7) |
| Sotho | 88 (15.7) | 118 (19.5) |
| Other | 29 (5.2) | 39 (6.3) |
| Alcohol at least once per month | | |
| Yes | 235 (42.0) | 100 (16.1) |
| No | 324 (58.0) | 521 (83.9) |
| Lifetime partners | | |
| One | 129 (23.1) | 211 (34.1) |
| Two | 120 (21.5) | 164 (26.5) |
| Three or more | 309 (55.4) | 244 (34.4) |
| Number of current relationships | | |
| None | 148 (26.6) | 149 (24.7) |
| One | 288 (51.9) | 383 (63.7) |

(Continued)

Table 1. Continued.

| | Men | Women |
|--|------------|------------|
| | n (%) | n (%) |
| Two or more | 119 (21.4) | 69 (11.5) |
| Partner concurrency ^a | | |
| No | 207 (37) | 228 (36.7) |
| Yes | 353 (63) | 394 (63.3) |
| At least one partner was 5 or more years older | | |
| No | 551 (98.4) | 401 (64.5) |
| Yes | 9 (1.6) | 221 (35.5) |
| Condom used always with last 5 casual partners | | |
| No | 467 (84.0) | 536 (87.9) |
| Yes | 89 (16.0) | 74 (12.1) |
| Age at first sex | | |
| ≤5 years | 158 (28.2) | 74 (11.9) |
| >15 years | 402 (71.8) | 547 (88.0) |
| Respondent would use a condom if partner so requested | | |
| No | 71 (12.7) | 72 (11.6) |
| Yes | 488 (87.3) | 546 (88.3) |
| Respondent would refuse to have sex with someone who refused a condom | | |
| No | 230 (41.4) | 220 (35.7) |
| Yes | 325 (58.6) | 396 (64.3) |
| Respondent would be able to refuse sexual intercourse if they did not want to have sex | | |
| No | 123 (22.0) | 98 (15.8) |
| Yes | 436 (78.0) | 523 (84.2) |

^aAt least one partner had an additional sex partner whilst in sexual relationship with respondent.

Discussion

The role that concurrency plays in the spread is characterized by ongoing debate. A number of studies have found no evidence of a link between partner concurrency and the risk of HIV (2–4). Other studies have found that concurrency is important in creating the connectedness of sexual networks that facilitate rapid HIV transmission (Kenyon 2013; Morris *et al.* 2010). The high levels of concurrency reported here could thus partly explain the extremely high HIV prevalence rates found in this population. What drives these high concurrency rates? This study found little evidence to back up the socioeconomic explanation. Concurrency rates did not correlate with income, education outcomes, being unemployed or type of employment on multivariate regression. Concurrency rates were, however, higher in those living in informal housing settlements. That this was equally the case for men and women and that this relationship persisted after controlling for the effects of income suggests that higher concurrency rates are not due to women in these settlements being forced by economic circumstances into taking on additional relationships with men from more wealthy areas. Instead, these higher rates may be due to a more tolerant norm toward concurrency in these

Table 2. Multivariate logistic regression analysis of risk factors for respondent concurrency.

| | Sexually active men (n=548) | | | Sexually active women (n=599) | | |
|--|-----------------------------|----------|---------|-------------------------------|----------|---------|
| | aOR | 95% CI | P-value | aOR | 95% CI | P-value |
| Age | | | .418 | | | .061 |
| 14–16 years | 1.0 | | | | | |
| 17–18 years | 1.5 | 0.6–3.5 | .344 | 1.4 | 0.5–4.4 | .546 |
| 19–21 years | 0.8 | 0.3–2.0 | .645 | 0.7 | 0.2–2.2 | .526 |
| 22–24 years | 0.8 | 0.2–2.5 | .671 | 2.0 | 0.6–7.3 | .284 |
| Married or living as married | | | | | | |
| No | 1 | | | 1 | | |
| Yes | 3.6 | 1.0–12 | .048 | 6.5 | 3.0–14.1 | <.001 |
| Living in informal housing settlement | | | | | | |
| No | 1 | | | | | |
| Yes | 1.8 | 1.0–3.3 | .035 | 2.7 | 1.5–5.1 | .002 |
| Migrant worker | | | | | | |
| No | 1 | | | NE | | |
| Yes | 1.7 | 0.7–4.2 | .245 | | | |
| Education completed | | | | | | .411 |
| None | NE | | | 1 | | |
| Primary | | | | 0.5 | 0.1–1.6 | .225 |
| Secondary | | | | 0.4 | 0.1–1.3 | .117 |
| Post matric | | | | 0.2 | 0.1–1.6 | .140 |
| Monthly Income | | | .198 | | | .298 |
| <R50 | 1 | | | | | |
| R50–R200 | 1.7 | 0.9–3.1 | .072 | 0.7 | 0.4–1.5 | .396 |
| >R200 | 1.4 | 0.6–3.0 | .436 | 1.3 | 0.6–2.9 | .537 |
| Occupation | | | .347 | | | |
| Trader | 1 | | | NE | | |
| Student | 1.2 | 0.3–4.1 | .788 | | | |
| Unemployed | 0.9 | 0.2–3.3 | .897 | | | |
| Other employment | 2.5 | 0.6–9.6 | .188 | | | |
| Ethnic group | | | .238 | | | .895 |
| Tswana | 1 | | | 1 | | |
| Zulu | 3.0 | 1.1–8.5 | .037 | 0.6 | 0.2–2.3 | .480 |
| Xhosa | 1.7 | 0.8–3.8 | .191 | 0.8 | 0.3–1.8 | .526 |
| Sotho | 1.3 | 0.6–2.8 | .519 | 0.8 | 0.3–1.8 | .572 |
| Other | 1.0 | 0.3–3.8 | .953 | 0.6 | 0.2–2.1 | .394 |
| Alcohol at least once per month | | | | | | |
| No | NE | | | 1 | | |
| Yes | | | | 3.1 | 1.5–6.5 | .002 |
| Lifetime partners | | | .000 | | | .078 |
| One | 1 | | | 1 | | |
| Two | 3.0 | 1.4–6.4 | .004 | 1.1 | 0.5–2.4 | .819 |
| Three or more | 7.6 | 3.8–15.1 | <.001 | 2.3 | 1.1–5.0 | .034 |
| Partner concurrency ^a | | | | | | |
| No | 1 | | | 1 | | |
| Yes | 8.2 | 4.8–13.9 | <.001 | 7.1 | 3.7–13.7 | <.001 |
| At least one partner was 5 or more years older | | | | | | |

(Continued)

Table 2. Continued.

| | Sexually active men (n=548) | | | Sexually active women (n=599) | | |
|--|-----------------------------|---------|---------|-------------------------------|---------|---------|
| | aOR | 95% CI | P-value | aOR | 95% CI | P-value |
| No | NE | | | 1 | | |
| Yes | | | | 2.5 | 1.3–4.6 | .005 |
| Condom used always with last 5 casual partners | | | | | | |
| No | 1 | | | 1 | | |
| Yes | 0.4 | 0.2–1 | .043 | 0.8 | 0.2–2.9 | .768 |
| Years since sexual debut | | | | | | |
| 0–3 | 1 | | .690 | | | .802 |
| 4–6 | 0.7 | 0.3–1.5 | .411 | 0.7 | 0.3–1.8 | .495 |
| >=7 | 0.7 | 0.3–1.8 | .487 | 0.8 | 0.3–2.3 | .642 |
| Respondent would use a condom if partner so requested | | | | | | |
| No | | | | NE | | |
| Yes | 0.5 | 0.2–1 | .049 | | | |
| Respondent would refuse to have sex with someone who refused a condom | | | | | | |
| No | NE | | | 1 | | |
| Yes | | | | 0.3 | 0.2–0.6 | .001 |
| Respondent would be able to refuse sexual intercourse if they did not want to have sex | | | | | | |
| No | NE | | | 1 | | |
| Yes | | | | 0.3 | 0.2–0.7 | .002 |

^aAt least one partner had an additional sex partner, whilst in sexual relationship with respondent.
NE, not entered; aOR, adjusted odds ratio.

communities. Of possible relevance in this regard, HIV prevalence was found to be higher in women in these communities in a multivariate regression analysis of the CYS that controlled for socioeconomic status (Auvert *et al.* 2001). Alternatively, our measure of income may not have adequately captured individuals' assets and incomes and as a result it may not have adequately controlled for economic differences. It should be noted that our measure of income (dividing all individuals into one of the three categories based on monthly income) was relatively crude. We had no alternative measures to use since no other information pertaining to income or assets was collected in the survey.

A number of studies from the USA have found concurrency to be positively correlated with socioeconomic status in men (Adimora *et al.* 2007) and lower socioeconomic status in women (Adimora *et al.* 2011). There is little evidence of the same relationship from the quantitative data from sub-Saharan Africa (Carter *et al.* 2007; Kenyon *et al.* 2010; Mah 2010; Sandoy *et al.* 2010; Xu *et al.* 2010). A study that investigated the correlates of concurrency in 22 countries (18 of them in Africa) found that in general wealthier and better educated men and women were more likely to have concurrent relationships (Mishra *et al.* 2009). In a study from South Africa, concurrency rates were found to be considerably higher among the Africans than the other racial groups after controlling for economic differences (Kenyon *et al.* 2010). This led to the authors concluding that cultural factors played an important role in the genesis of the high concurrency rates.

If concurrency is not patterned along the lines of class then how is it patterned? The association between concurrency and older partners in women is not a new finding (Steffenson *et al.* 2011) and is likely a significant factor in promoting HIV spread (Mah *et al.* 2010). The positive relationship between concurrency and marital status found here, although strong, involves only 121 individuals. The relationship between marriage and concurrency in other studies is complex depending on things such as age-at and length-of-marriage (Xu *et al.* 2010). In general, studies from first world settings have found lower concurrency rates among those who are married and those who are in more committed relationships (Adimora *et al.* 2011; Youm & Paik 2004). Numerous studies from Africa have, however, found marriage to be a risk factor for concurrency (Boerma *et al.* 2002; Carter *et al.* 2007; Sandøy *et al.* 2010).

The correlation between concurrency and the attitudinal variables is suggestive that concurrent relationships may be afflicted by considerable male–female power imbalances. A study based on a nationally representative household study from South Africa reported very similar findings; female concurrents were, for example, more likely than monogamists to agree that 'there are times when I do not want to have sex, but I do because my partner insists on having sex' (Steffenson *et al.* 2011). These associations were not, however, tested in a multivariate analysis. Our results test this association by controlling for a wide variety of other factors. In addition, they show that men who would use a condom if their partner asked them to, report lower

concurrency rates. Answering yes to this question could be indicative of men who are more likely to take the views of their partner into account. The relationship between attitudes and concurrency for both the men and women thus suggest that relationships characterized by more gender inequality are more predisposed to concurrency. Since a longitudinal study from South Africa has established that relationship inequality is associated with incident HIV infection in women (Jewkes *et al.* 2010), the relationship we describe here between relationship inequality and concurrency could be a mediating pathway.

This study replicates the findings of the strong correlation between partner and respondent concurrency, found elsewhere. Partner concurrency was the strongest predictor of concurrency with ORs of 7 and 8 for women and men, respectively. This relationship has been found to be similarly strong in a number of other studies (Adimora, Schoenbach & Doherty 2006; Adimora *et al.* 2011; Mah 2010). Four reasons have been put forward to explain this link: some multi-partner respondents may project their concurrency onto their partners (Ferrand, Marquet & Van Campenhoudt 1998); individuals who engage in concurrent partnerships may be more attracted to others with the same disposition (Mah 2010); persons who learn that their current partner has a concurrent partner may be encouraged to do likewise; and persons in whom a previous partner has engaged in concurrency may be more likely to have more than one partner at a time in future relationships (Xu *et al.* 2010).

Only one study that we are aware of has tried to look at the sequencing of the relationship between partner and respondent concurrency. A study using life-history-calendar data from a population-based sample of 18–24 year olds in Kenya found that if respondents thought that their first sexual partner had other partners they were two times more likely to engage in concurrent relations themselves in their next relationship (Xu *et al.* 2010).

It is plausible that experiencing partner concurrency may increase an individual's tendency to engage in concurrency during the current and or future relationships. We were, however, unable to replicate these findings. There was a strong relationship between current partner concurrency and respondent concurrency but none between first partner concurrency and subsequent respondent concurrency (Model C) and none between any previous partner concurrency (excluding those whose current partners have concurrents) and current respondent concurrency (Model B).

It is possible that the life-history-calendar methodology collects more accurate information about people's sexual history and that this explains the discrepancy in findings. It is also possible that the considerably higher prevalence of respondent concurrency in Carletonville is responsible for the lack of a relationship between previous partner concurrency and current respondent concurrency. The prevalences of concurrency 6 months prior to the survey for sexually active men and women, respectively, were 9.4% and 6.2% in Kisumu, and 21.3% and 11.4% in Carletonville. In the setting of a place like Kisumu where the practice of – and norms underpinning – concurrency are less pervasive,

it is plausible that individuals start their first sexual relationship with more of a commitment to monogamy than in a place like Carletonville where concurrency is more widely practiced and possibly more accepted as normative. Individuals in Kisumu might then be more susceptible than those in Carletonville to perceptions of partner concurrency in the first relationship(s).

The programmatic significance of this life-course approach is that if the experience of partner concurrency in an individual's first relationship(s) has a large bearing on subsequent concurrency then emphasis needs to be placed on people in these age groups. Likewise, one would expect a long delay before program targeting concurrency would successfully bring down sexually transmitted infection incidence. The speed with which one-partner-at-a-time campaigns bore fruit in Uganda and elsewhere suggest this is not the case (Kirby 2008). The way the association between various measures of partner and respondent concurrency is patterned in the CYS could also be explained by persons who engage in concurrency projecting this behavior onto their partners. However, where this has been examined by tracking and interviewing the partners of respondents, the respondents had tended to underestimate the prevalence of partner concurrency (Drumright, Gorbach & Holmes 2004).

Our findings are subject to the well-described limitations of self-reported data related to understanding, recall and communication. In addition, due to their unavailability in the CYS, we were unable to include a number of variables in our models that have been shown to play a role in the genesis of concurrency – such as the social embeddedness of relationships (Kenyon *et al.* 2010). The results pertain to a young population in a mining-dependent town and were obtained from a survey performed in 1999. The results may, therefore, not be generalizable beyond this population.

This study concurs with the findings of other studies that found that high concurrency rates in South Africa are not patterned along socioeconomic lines (Kenyon *et al.* 2010). Qualitative studies confirm a widely shared tolerance of additional secret partners in this region (Jana, Nkambule, Tumbo, Goldstein & Weiner 2007; Kenyon, Osbak, Buyze, Johnson & van Lankveld 2014). There is a very strong association between current partner and respondent concurrency which does not show evidence of being determined by previous partner concurrency. If an individual's probability of taking on concurrent partners is to a large extent determined by whether or not their current partner is, or is perceived to be, engaging in concurrency then the phenomenon of concurrency is self-amplifying. The converse is, however, also true. If a critical mass of individuals is motivated to reject concurrent partnering, then concurrency rates could, as a result, fall rapidly. There is clearly much more work that needs to be done to understand and respond to the interplay of factors leading to such high concurrency rates among young persons in Southern Africa.

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