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CONCURRENT SEXUAL PARTNERSHIPS AND HIV TRANSMISSION IN KHAYELITSHA, SOUTH AFRICA

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Abstract

Concurrent partnerships – two or more partnerships that overlap in time – play a critical role in HIV transmission dynamics. By better understanding the epidemiological and socio-cultural role of multiple concurrent partnerships, primary behavior change approaches to HIV prevention can be more effective and appropriately targeted in sexually-transmitted, generalized epidemics such as in South Africa. This paper contributes to the growing body of knowledge about the role that concurrent sexual partnerships play as a risk factor for HIV infection. The first section reviews the literature on concurrent partnerships. The second section presents data on the frequency of concurrent sexual partnerships and correlates of such partnerships using a representative sample of adults in Khayelitsha. The analysis found that 17% of adults in married or regular partnerships reported concurrency, with men reporting significantly more concurrency. Engaging in concurrency was correlated with being less religious and with knowledge that your primary partner also had concurrent partners.

Introduction

The South African response to the HIV epidemic is critical, given the large number of people living with the virus as well as the continued high incidence of infection. HIV prevention in South Africa must be prioritized to improve the well-being of its population and decrease future strains on health systems and impediments to economic growth. Since the epidemic is primarily driven by sexual transmission, behavior change is an important area of intervention. Concurrent sexual partnerships are an under-researched area of sexual behavior that can serve as one focal point for effective, preventative sexual behavior change. Increasingly, calls to design and implement interventions that attempt to change sexual behaviors recognize the importance of multiple and concurrent partnerships. For instance, in May 2006, an expert think-tank meeting in Lesotho, convened by the Southern African Development Community (SADC), concluded that priority should be given to interventions that "reduce the number of multiple and concurrent partnerships" (SADC HIV and AIDS Unit - SADC Secretariat, 2006).

This paper examines concurrent sexual partnerships in Khayelitsha, South Africa. Specifically, data on sexual partnerships are examined to estimate the frequency of concurrency and to better characterize individuals who participate in concurrency. The first sections of the paper describe the HIV/AIDS epidemic in South Africa and provide a brief description of concurrency[1]. The second section contains an analysis of sexual history data collected in 2005 in Khayelitsha. The analysis provides evidence to suggest that concurrent sexual partnerships are common in this population and that prevention interventions should begin to address this high risk behavior.

The HIV Context

At the end of 2007, there were an estimated 22.5 million [1.4 million–2.4 million] people living with HIV in sub-Saharan Africa, representing over two-thirds of the global burden (UNAIDS, 2007). Although there is evidence of prevalence declines in some epidemics in sub-Saharan Africa, a majority of southern African epidemics appear to have stabilized, though at very high levels

[1] For a fuller discussion of the literature on concurrency, see Mah & Halperin, "Concurrent sexual partnerships and the HIV epidemics in Africa: Evidence to move forward," *AIDS and Behavior* 2008.

(Mbulaiteye et al., 2002, Stoneburner and Low-Beer, 2004, Green et al., 2006, Gregson et al., 2006, Mahomva et al., 2006, Sandoy et al., 2006, Bessinger et al., 2003). Overall, the HIV epidemics across sub-Saharan Africa tend to be heterogeneous, both in terms of their epidemiological nature and trends over time, and such heterogeneity occurs both between countries and within countries. The generalized epidemic of South Africa is no exception.

Estimates for HIV prevalence in South Africa vary greatly. In its 2006 Epidemic Update, UNAIDS estimated that 19% of adults, age 15-49, were HIV infected (UNAIDS, 2006b). In 2005, a population-based survey by the Human Sciences Research Council (HSRC/Mandela Survey) reported a national HIV prevalence of 16% among the adult (age 15-49) population in South Africa, with an estimated 5.4 million infected, representing the largest number of people living with HIV/AIDS in any country in the world (Shisana et al., 2005). Prevalence models built using parameters specific to the South African epidemic by the Actuarial Society of South Africa (ASSA) found a high level of correlation between their models and the 2005 population-based survey, adding credence to the lower estimates by the HSRC-Mandela study (ASSA AIDS Committee, 2006). Large disparities among sub-populations in South Africa exist: overall, females have a higher prevalence than males (13% versus 8%); prevalence peaks among women aged 25-29 (33%), while among males it peaks later between ages 30-39 and at a lower level (23%); see Figure 1; prevalence in KwaZulu Natal Province (16%) is three times higher than the Western Cape Province (5%); Black Africans are more than seven times more likely to be infected than their White, Coloured or Indian compatriots (13% versus 0.6%, 2%, and 2% prevalence age 2+ years) (Shisana et al., 2005).

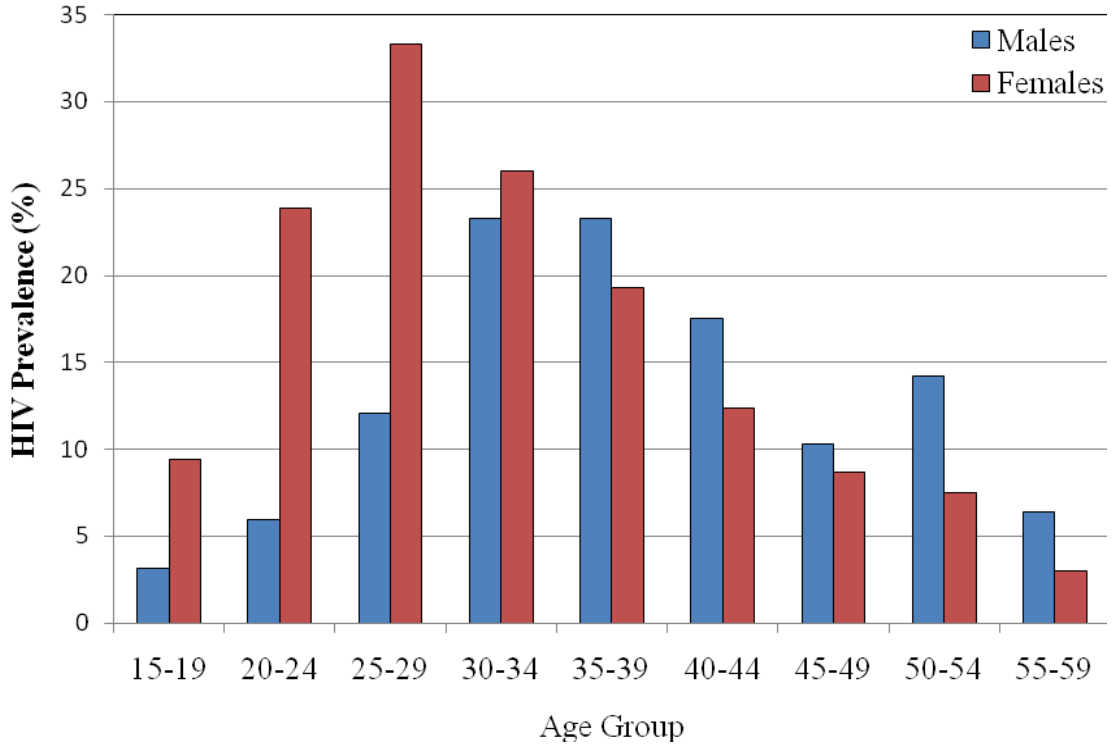

Figure 1. HIV population prevalence by age in South Africa, 2005

Similarly diversity in HIV prevalence exists in the Western Cape. The population-based HIV/AIDS estimate of adult (15-49) prevalence is 6% in 2005 in the Cape Metropole Area, compared to 3% in Western Cape Province and 16% nationally. (City of Cape Town, 2006, Shisana et al., 2005). Population-based prevalence measures for the sub-district of Khayelitsha are not available. The antenatal clinic estimate of HIV prevalence in 2006 for Western Cape was 15%, which is lower than the national antenatal prevalence of 29% (Western Cape Provincial Department of Health, 2006). However, there is significant heterogeneity in HIV prevalence at the district and sub-district levels (Shaikh et al., 2006). Ante-natal clinic surveillance prevalence estimates in Khayelitsha are highest (33% in 2006) and are similar to other parts of the country, including KwaZulu-Natal. Prevalence in Mitchell's Plain is significantly lower than Khayelitsha (11% in 2006). Significant heterogeneity exists even among the communities in the Cape Metropole sub-districts. For instance, prevalence from ante-natal clinic surveys range from 4% in Klein Karoo to 33% in Khayelitsha in 2006 (Western Cape Provincial Department of Health, 2006). Based on the data presented above, it is evident that the HIV epidemic in Khayelitsha is severe both in absolute and relative terms and may be indicative of differences in behavioral or biological determinants of HIV infection within this population.

Concurrent Partnerships

Concurrency is increasingly being noted as one element of sexual partnerships that plays a critical role in HIV transmission dynamics (SADC HIV/AIDS Unit - SADC Secretariat, 2006, Shelton, 2007, Halperin and Epstein, 2007, Hankins, 1998, Epstein, 2004, UNAIDS, 2006a, Mah and Halperin, 2008). Concurrency or concurrent partnerships have been variably defined and measured in the literature. In general, concurrent partnerships are sexual relationships whereby an index partner has overlapping relations with two or more partners. This is contrasted with sequential or serial monogamy, whereby an individual engages in a sexual relationship with only one partner at a time, with no overlap with subsequent sexual partners. Concurrent partnerships can vary according to the length of the "additional" sexual partnerships (or the duration of overlap of partnerships) and the frequency of sexual intercourse. These variables largely determine the epidemiological importance that is attributed to concurrency in any particular case.

The term "concurrent partnerships" was first addressed in the epidemiological literature over 15 years ago. In one of the earliest articles citing the term, Watts and May (1992) developed a mathematical model, based on HIV transmission per partnership as opposed to per act, to demonstrate that the rate of spread of infection is much faster when concurrency is present. Shortly thereafter, Hudson (1993) proposed that observed differences in HIV prevalence between and within countries could be partially determined by varying levels of prevalence of concurrent sexual partnerships. Hudson (1996, , 1998) hypothesized that due to high levels of viremia during initial infection, epidemic spread of HIV would tend to occur in populations that have high rates of simultaneous partners (i.e. concurrent partners).

Watts and May's early mathematical models showed how concurrent partnerships could theoretically promote the spread of HIV, though their modelling results may have been confounded by not holding the number of sexual partners constant. In 1996, using the more sophisticated technique of stochastic modelling, Kretzschmar and Morris found that for a fixed mean number of partners per individual, the distribution of the contact patterns, ranging from serial monogamy to concurrency, had a major influence on the speed of the spread of an epidemic (Kretzschmar and Morris, 1996, Morris and Kretzschmar, 1997). Using observed data from a Ugandan population and simulation models, Morris and Kretzschmar investigated how increases in levels of concurrency and the number of partnerships would affect epidemic spread. At

the time of the survey, the researchers found that approximately 15% of men and 2% of women had more than one on-going sexual partnership. 16% of the surveyed women reported concurrency at any point during the previous three months. According to the researchers, these low numbers of concurrent partnerships may reflect behavior change that had resulted from prevention interventions during the late 1980s. The researchers concluded that increasing concurrency had a more significant impact on epidemic spread than increasing the number of partnerships (Morris and Kretzschmar, 2000). In comparing serial monogamy to concurrency in 50% of the partnerships, over five years, the researchers estimated that the epidemic was about ten times as large in the latter scenario (Morris and Kretzschmar, 1997).

Biological Plausibility

Variability in viremia over the course of HIV infection, and in particular high viral loads during acute infection, provides the biological foundation for the role that concurrency plays in HIV transmission dynamics. During acute infection, defined approximately as the first three weeks to two months following viral acquisition, viral replication is relatively unchecked by host immune responses, resulting in high viral loads in both blood and semen (Galvin and Cohen, 2004); see Figure 2. Chakraborty *et al*. (2001) developed a probabilistic empiric model, linking biological and epidemiological data to demonstrate that increased efficiency of HIV-1 transmission was expected when the concentration of HIV-1 in semen increased. Wawer, *et al*. (2005) using data from Rakai, Uganda calculated that HIV transmission probability within the first five months of sero-conversion was 8.1/1000 sex acts, compared to 1/1000 and 4.2/1000 among individuals in asymptomatic or late HIV infection. A secondary analysis of these data found that the average per-act transmission probability was even more pronounced during acute infection compared to chronic HIV infection (0.03604 versus 0.00084) (Pinkerton, 2008). Pilcher *et al*. (2004) provide empirical evidence to suggest that men with acute HIV-1 infection are biologically hyper-infectious because of increased genital shedding of HIV. Additionally, the researchers hypothesized that HIV infected men, without STD co-infection, would infect 7-24% of their female sex partners during the first two months of infection; if either partner had an STD, this rate could exceed 50%. Other research has also demonstrated the increased likelihood of transmission during the primary or acute stage of infection (Quinn et al., 2000, Leynaert et al., 1998, Brenner et al., 2007, Galvin and Cohen, 2004).

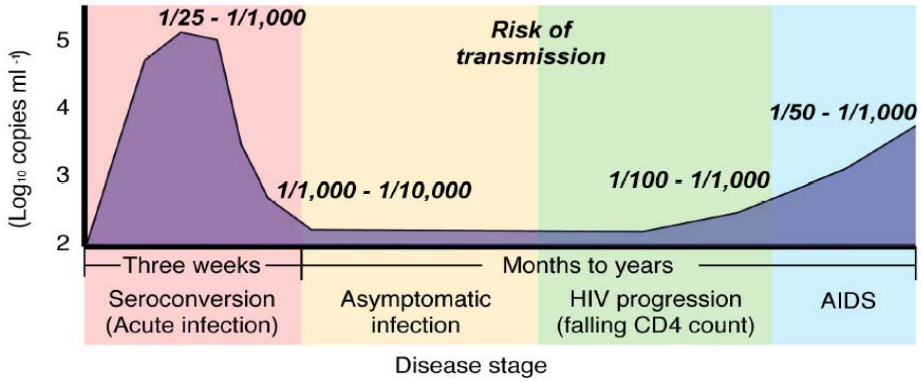

Figure 2. HIV viral load and risk of sexual transmission during different stages of disease (from Galvin & Cohen, 2004).

Concurrent partnerships increase the probability that uninfected partners will have sexual intercourse and therefore be exposed to a partner during acute infection. This is because in regular, as opposed to casual partnerships, there may be a higher number of coital acts along with less condom use. Additionally, given the time overlap in partnerships, earlier partners with whom an individual is still sexually active, are still at risk for HIV infection via current and future overlapping partners. This transmission network effect cannot occur in serial partnerships. During serial partnerships, given the time gaps between sexual relationships, few and possibly only one uninfected partner will typically be exposed to an infected partner during the acute infection stages. This will result in a lower per act risk of transmission and put fewer individuals at risk. These factors related to increased risk as a result of concurrency can operate independently of the increased risk associated with higher numbers of sex partners. This may be one factor that confounds the relationship between the number of sex partners and HIV prevalence.

Defining and Measuring Concurrency

In order to determine whether the modeling studies described above are accurate representations of real-life sexual partnerships, it is necessary to measure the prevalence of concurrent relationships in populations. In the literature, numerous definitions of concurrency are utilized and methods for measurement vary. There is not currently a single definition of concurrency or a universally accepted method of measurement, though various definitions and measures have been proposed (Morris and Kretzschmar, 1994, Le Pont et al., 2003, Lagarde et

al., 2001). This critical area needs attention, since reports of concurrency are not always directly comparable.

There are two general measurement methods that have been used to collect partnership and concurrency data. The first asks an interviewee directly if he/she has *other* sexual partners during a specific partnership(s). This can provide a rough estimate of the number of individuals interviewed who have been in concurrent relationships over a given recall period. However, if characteristics of the partner or partnership are not also collected, it is difficult to determine the epidemiological importance, since some partnerships may be one-time sexual encounters. A second method is a calendar method, in which detailed information about previous partnerships – including the start and end dates of sexual relationships – usually months and years – and characteristics of the partners (e.g. regular, casual, commercial, etc.) – are collected to create a sexual partnership calendar. This method allows for various definitions of concurrency to be calculated. For instance, concurrency can be defined by different periods of partnership overlap or can include/exclude casual partnerships. Though this partner calendar method provides more data, there may be recall bias/error related particularly to the start and end dates of partnerships. This can severely limit a researcher's ability to accurately create such partnership calendars. This methodology also requires more questions to be asked compared to the first method to be collected in order to calculate a measure of concurrency. Given limited resources, survey designers may opt to not include such lines of questioning.

In comparing these two methodologies among young adult visiting STD clinics in the US, Nelson *et al*. (2007) found that reporting of concurrency was common in both methodologies, however the results were not interchangeable. 29% of those reporting concurrent partners by direct question did not do so by overlapping dates and 26% of those reporting concurrency by a calendar method did not do so by direct question. These findings by Nelson may not be generalizable, particularly to populations in developing countries, given the sample population. Morris and O'Gorman (2000) found that measurement errors (unit heaping and recall bias) are likely to have only a small impact on estimates of concurrency.

Recent Demographic and Health Surveys have begun collecting data on the past three sexual partners using a calendar method. However, early surveys, which have collected these data, are thought to underestimate the prevalence of concurrency. For instance, a preliminary [unpublished] analysis of the 2005

Zimbabwe DHS found that an extremely small proportion of the population reported being in a concurrent relationship, despite qualitative reports indicating higher levels of concurrency. This underreporting could be an artefact of social-desirability and/or self-reporting bias. Given the personal nature of such questions, individual surveys that do not guarantee privacy may not be the most appropriate methodology for collecting such data.

Empirical Evidence

As concurrency has gained weight as a potentially important driver of HIV epidemics and even before, studies have attempted to measure the prevalence of concurrency among specific populations. The prevalence of concurrency is highly dependent on both the definition of concurrency as well as the recall period and therefore, studies should be interpreted and compared cautiously.

In the early 1990s, WHO/WPA surveys found that the percentage of 15-49 year old men who report more than one regular partner was highest in sub-Saharan African countries or sites (including Lesotho – 55%; Côte d'Ivoire – 36%; Lusaka, Zambia – 22%) and was much lower in Asian or Latin American countries or sites (including Manila, Philippines – 3%; Singapore – 2%; Thailand – 3%) (Caraël, 1995). See Figure 3. Though HIV sero-status was not collected along with these behavioral surveys, HIV prevalence was generally higher in sites where more men and women reported having more than one regular partner.

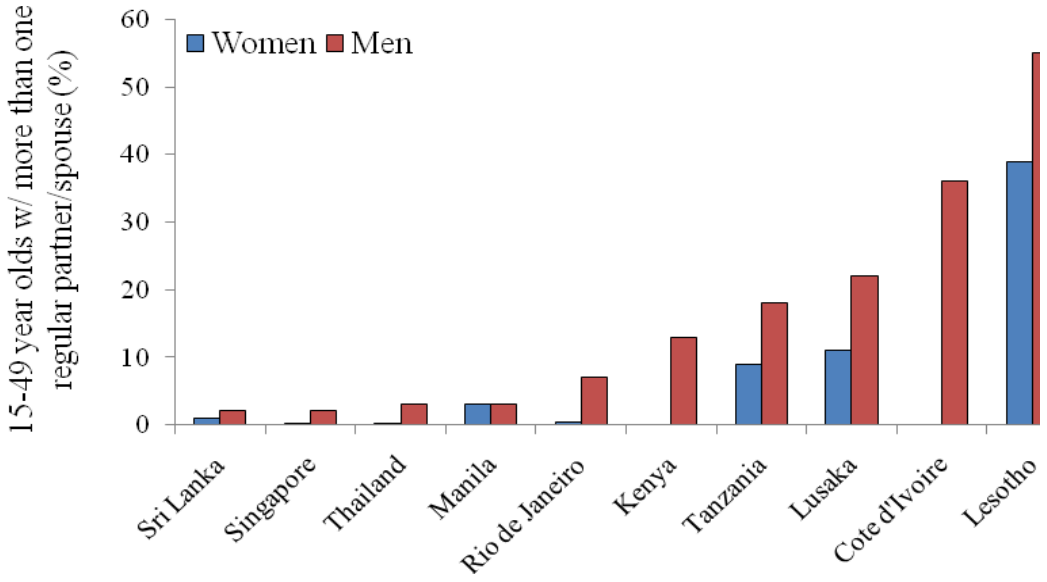

Figure 3. Global reporting of 2+ regular partners, 1990s (from Caraël, 1995).

A 1999 study of 15-29 year old men and women in rural and urban areas of Kenya found that at the time of the survey, 11% and 3% of married men and women, respectively, and 26% and 6% of nonmarried men and women, respectively in urban areas (Kisumu) were engaged in concurrent partnerships. In rural areas, reporting was similar, except among married men, of which 27% were engaged in concurrent partnerships (Voeten et al., 2004). A 2004 study on sexually active young men (aged 18-24) in Kisumu, Kenya found that 63% had at least one concurrent partnership in their lifetime. Of those, 49% had 3 or more instances of partnership overlaps (Mattson et al., 2007).

A 1995 survey in rural KwaZulu Natal, South Africa found that 40% of sexually active men report more than one partner during the past three months, though it is not known if those relationships were serial or concurrent (Colvin et al., 1998). The authors of the study state that such high reporting of multiple partners is most likely indicative of concurrency rather than serial partnerships in this population. In Eastern Cape Province, South Africa, a 2005 study of young men, aged 15-26, found that 55% of the population reported having one or more concurrent partners (Jewkes et al., 2006). A 2006 study in Swaziland found that 70% of males and 62% of females reported having 2 or more partners in the last three months (James and Matikanya, 2006). Though the overlap between relationships was not measured, the high frequency of two or three

partners suggests that a large proportion of the population in Swaziland are engaged in concurrent partnerships.

A 2003 population-based survey in Botswana found that 23% of sexually active respondents reported having a concurrent partnership with any of the last three partners from the last 12 months (Carter et al., 2007). Additionally, they found that men and youth (age <25 years) and non-religious people were more likely to report concurrency. Another survey in 2003 in Botswana found a similar prevalence of concurrent partnerships in the past year among sexually active respondents (18-22%) (Meyerson et al., 2003). A 2007 qualitative study in Botswana found that concurrent partnerships are widespread and exist for various reasons, including material gain, sexual satisfaction, peer pressure and related social norms (Nkwe and Limwame, 2007).

A study of three countries in the Caribbean region – Martinique, Guadeloupe and Guyana – found that levels of concurrency were highly dependent on the definition of concurrency and the algorithm used to define it. Using a definition of at least two current partners at the time of the interview, 13-14% of the population in each country were in concurrent partnerships. A broader definition of concurrency, i.e. declaring more than one partner at one point in time, yielded higher levels of concurrency, ranging from 33% in Guadeloupe to 26% in Martinique (Le Pont et al., 2003).

Some research has found that concurrent partnerships are not a major determinant of the rate of spread of HIV. Lagarde *et al*. (2001) in the "four cities" study "could not find evidence that concurrent sexual partnerships were a major determinant of the rate of spread of HIV in five cities in sub-Saharan Africa". However, the study measures *current* concurrency, rather than concurrency over a longer recall period, which could have underestimated the prevalence and therefore the effects of concurrency, and (2) no measure of partnership overlap was recorded, some of the concurrent partnerships may have been commercial or casual sex encounters, which have a different epidemiological effect, as mentioned above.

Several studies in the US have examined the relationship between concurrency and the transmission of sexually transmitted diseases. Potterat *et al*. (1999) found that the presence of concurrent sexual contacts was strongly related to status as a transmitter of *Chlamydia trachomatis* (OR=3.2; $p<0.001$). Koumans *et al*. (2001) found that individuals with concurrent partners were significantly more likely to transmit syphilis than individuals without concurrent partners

(OR=2.3; 95% CI: 0.9 – 6.3). Rosenberg *et al*. (1999) found that among adolescents seeking care at a public STD clinic, 31% of those reporting at least one main partner in the previous six months had a concurrent partner. This was associated with STD diagnosis, after controlling for the number of sexual partners (OR=1.6; 95% CI: 1.1-2.4). Gorbach *et al*. (2005) found that partnership-level STI was associated with several characteristics, including concurrency (OR=3.8; p=0.03). In a study to assess the relationship between STI and individual and a partner's concurrency status, Drumright *et al*. (2004) found that diagnosis of an STI in an individual was associated with the partner's concurrency (OR=3.58; 95% CI: 1.15-11.2). Using a random-digit-dialling survey in the US, the Manhart *et al*. (2002) found that concurrency was independently associated with individual STD risk and that men reported concurrency more frequently than women.

In several studies among African-American populations, Adimora *et al*. (2004) found higher levels of reported concurrency, compared to other racial groups in the US. The researchers report that concurrency prevalence in the African-American population in the past five years was 53% (men) and 31% (women) and that most (61%) respondents believed that a recent partner had had a concurrent partnership. Although HIV sero-status data were not collected, the researchers hypothesized that concurrency had important implications for HIV transmission in this population. Adimora *et al*. (2007) reported that 11% of men in the US reported concurrent partnerships in the year preceding the survey. Adimora *et al*. (2002) also reported prevalence by racial categories for women in the US: 21% among blacks, 11% among whites, 8% among Hispanics, and 6% among Asian American and Pacific Islanders. Lenoir *et al*. (2006) found that among adolescent couples in a study population in the US, agreement between perceptions of sex-partner concurrency and partner-reported behavior was low. And those individuals who presume that they are in a mutually monogamous relationship often underestimate their own sexually transmitted disease risk.

One major difficulty in assessing the relationship between HIV incidence and concurrency is that an individual's engagement in concurrent partnerships will not necessarily be directly correlated with HIV acquisition. For instance, an individual with three concurrent partners is not at higher risk for HIV acquisition if those partners do not have multiple partners compared to an individual with three serial partners. Concurrency plays an important role in transmission dynamics when an individual's partner also has concurrent partners. Morris (2001) in an editorial writes:

> ‘It seems the most natural thing in the world to predict the disease status of an index case as a function of concurrent partnerships, controlling for the number of partners in order to see if concurrency has an independent effect...The basic point is that concurrency creates a risk for the partner, not the index case.’

A study among STI clinics and communities in Seattle, Washington examined the rationale for engaging in concurrent partnerships. The researchers identified six main forms of concurrency: experimental, separational, transitional, reciprocal, reactive, and compensatory (Gorbach et al., 2002). Experimental concurrency is exploratory in nature, often only lasts for one or two nights, and where partners have no expectations of exclusivity. Separational concurrency occurs during physical separation between partners (e.g. geography, employment, imprisonment) and is potentially known to each main partner, but is not openly discussed. Transitional concurrency occurs at the beginning of relationships before partners agree to mutual sexual exclusivity or as a relationship begins to “disintegrate”. Reciprocal concurrency is an open partnership, where both main partners understand that outside partnerships are not serious. Reactive concurrency occurs when one partner gains additional partners in response to his/her partner’s non-exclusivity. Compensatory concurrency occurs when one partner gains additional partners because of perceived deficiencies in the main partnership (Gorbach et al., 2002). Though these forms of concurrency may not be directly applicable to the southern African context, they provide a basic framework from which to begin understanding the rationale for engaging in concurrent partnerships.

An Historical and Qualitative View of Concurrency in Southern Africa

The social, cultural and economic contexts of patterns of sexual behavior and partnering practices vary greatly between different regions and countries. The following anthropological view of concurrency focuses on the southern Africa region because of the current burden of HIV and because of the presumed high frequency of concurrent partnerships.

In the southern Africa region and in South Africa in particular, there is a small body of literature in the fields of public health and socio-medical sciences that has examined the socio-cultural nature of concurrent relationships and infectious

disease propagation. Anthropological literature and more recently gender studies literature have made attempts to describe multiple and concurrent partnerships in the context of the rapid political and socio-demographic shifts that have occurred in South Africa. The underpinnings and justifications for concurrent partnerships are multiple and diverse.

Some historical justifications of multiple concurrent partnerships lie in biology and polygyny. Spiegel writes, "[I]nformants referred to their own conceptions of the institution of polygyny in order to make sense…of a contemporary practice [i.e. multiple partnerships] which they knew to be morally non-normative" (1991). Selikow writes "[u]sing the language of tradition and biology, leads to the belief that some practices are 'meant to be,' as they are based in biological realities and/or tradition" (2004). In both of these writings, concurrent partnerships are seen as culturally rooted social structures that have existed and continue to exist, despite social changes and changes to the health risks (i.e. HIV/AIDS) associated with such practices. Another explanation describing the roots of concurrency relate to the migrant labor system of southern African mines and industrial areas. This resulted in men and women spending significant amounts of time away from each other, which has implications for multiple partnering and marital 'infidelity' (Spiegel, 1991, Romero-Daza, 1994).

In addition to historic cultural explanations, recent socio-demographic and economic changes in South Africa have greatly impacted the nature of sexual relationships. Quickened in part by the beginning of democracy in South Africa in 1994 and rapid 'globalization', the transactional nature of relationships in South Africa – different than the phenomena of 'survival sex' and 'prostitution' - has shifted and plays a critical role in the number of sexual partners and the timing of those relationships (i.e. the concurrency) for men and particularly for women (Leclerc-Madlala, 2003, Selikow et al., 2002, Hunter, 2002). Leclerc-Madlala (2002) writes:

> 'For reasons not unrelated to post-apartheid 'liberalisation' of markets, privatisation, growing urban unemployment, and the media promotion of conspicuous consumption, multi-partnered transactional sexual relationships have come to play an integral role in the lives of many urban young women.'

Kaufman and Stavron (2002) found that among young people in urban South Africa, gift-giving and a transactional aspect of relationships was common and widely accepted. Hunter (2002) found that the association between sex and gifts

(i.e. transactional sex) has been a central factor in driving "multiple-partnered sexual relationships" in KwaZulu-Natal Province. In examining the gender dynamics of such transactional relationships, Hunter (2002) and Leclerc-Madlala (2002) both found that women were often not "passive victims" of such relationships but rather acted to "access power and resources." Leclerc-Madlala (2002) further writes that "[m]aintaining relationships with more than one partner concurrently was viewed as a 'modern' activity and not uncommonly framed by discourses on gender equality and human rights". In writing about language, sexuality and HIV/AIDS, Selikow (2004) found that male sexuality in townships is defined by how many sexual partners men have and is encapsulated in the terms such as *ingagara* – a "real man" or "top dog" – and *isithipa* – a man without many girlfriends, unfashionable, and unpopular.

Several recent qualitative studies in the public health literature have examined the social and cultural context of concurrent partnerships in southern Africa. Motivators for engaging in concurrent partnerships include exchange of material goods and money (as a socially normative behavior, distinct from "commercial sex"), sexual dissatisfaction with one sexual partner, an emotional "safety-net" against losing a main partner, peer and social pressures, particularly among young people, and social acceptance of having multiple partners (Parker et al., 2007, Psaki et al., 2008, Epstein, 2007).

Concurrency in Khayelitsha

The following sections of this paper describe the occurrence and correlates of reported concurrency among a representative adult population in Khayelitsha, Western Cape.

Hypotheses

This analysis examines three hypotheses:

1. Reported levels of concurrency differ by sex, with men more likely to report concurrency than women.
2. There is a direct relationship between income and reported concurrency, with individuals with higher income levels reporting more concurrency than lower income-level individuals.

3. Highly involved (either with community or religious organizations/groups) individuals will report less concurrency than those who are less engaged at the community level.

Design and Methods

Data

This analysis utilizes data collected from 2000-2005 as part of the Khayelitsha-Mitchell's Plain Survey (KMP Survey), later called the Khayelitsha Panel Survey (KPS). The surveys were designed and implemented by researchers at the University of Cape Town's School of Economics and subsequently by the Centre for Social Science Research (Cape Town, Western Cape Province). The main objective of the KMP/KPS Survey was to "explore labour-market behaviours and socio-economic characteristics of the Mitchell's Plain magisterial district" (Magruder and Nattrass, 2005). Although the original 2000 KMP Survey was not conceived as a panel study, subsequent funding and research interests allowed additional survey waves to be conducted. In 2004 and 2005, researchers re-interviewed individuals surveyed in Khayelitsha Township to examine changes in labor-market behaviours (Waves 2 and 3). In addition to labour-market and socio-economic data being collected, Waves 2 and 3 collected data on health and health-seeking behaviors, including information on HIV/AIDS and intimate sexual partnerships. Though some data were collected longitudinally, in-depth sexual partnership data were only collected in Wave 3. Therefore the following analysis is cross-sectional, not longitudinal.

The survey sample for the 2000 KMP Survey was drawn using a two-stage cluster technique based on the 1996 population census (Crankshaw et al., 2001, Crankshaw and Welch, 2001). The first stage selected clusters of households based on the enumerator areas (EAs) and the second stage selected households. The EAs were designed to be homogenous with respect to housing type (i.e. squatter camps, site and service settlements, hostels, formal council estates and privately built estates) and all non-residential and institutional (except hostels) EAs were excluded from the sampling. This methodology thereby stratifies the sample by location and by housing type. During the first stage, a random sample of EAs (n=108) was selected with probability of selection being proportional to population size. During the second stage, households were listed and selected based on a sampling interval (1 573) to ensure that at least 10 households per

EA were selected with an expected response rate of 80%. The first house was randomly selected, with subsequent households selected based on the sampling interval. All adults (age 18 and over) were interviewed in the selected households. Households were revisited up to three times to obtain the necessary interviews (Crankshaw et al., 2001).

Study Participants

The 2000 KMP Survey collected data on 2 466 adults (over the age of eighteen) from the Mitchell's Plain magisterial district. The district encompasses the African townships of Khayelitsha, Langa, Gugulethu, Nyanga and Crossroads and the coloured township of Mitchell's Plain. Fifty-two percent (52%) or 996 of the black African sample population were from the township of Khayelitsha. Future (2004 and 2005) waves sampled only from the township of Khayelitsha, not from the entire 2000 study population. In 2004, during Wave 2, researchers were successful at following up a large proportion of those sampled in Khayelitsha. 570 interviews were conducted, out of a possible 966 potential Khayelitsha respondents. In the 2005, during Wave 3, a total of 536 interviews were conducted.

The attrition rates from 2000 to 2004 among four-year residents of Khayelitsha was 29.1% (Magruder and Nattrass, 2005). A previously published analysis on attrition between the 2000 KMP and the 2004 Khayelitsha Panel Survey found that attrition bias was evident, but not particularly strong. The attrition between 2004 and 2005 was comparable to several other panel surveys in developing countries as indicated by Magruder and Nattrass (Magruder and Nattrass, 2005, Lee, 2003, May and Roberts, 2001). Probit regression models found that household size, gender and housing types were significant determinants of attrition, but their impact on the probability of attrition was relatively small. Aside from gender, these significant determinants of attrition between 2000 and 2004 did not to have an impact on this analysis. An attrition analysis was not conducted on the attritors between waves 2 and 3. Between the two waves, less than 30 individuals attrited. The small attrition was assumed to not have an impact on this analysis, unless there was a common characteristic that would impact on their sexual behaviors.

This analysis is limited to individuals who report having at least one sexual partner in the past twelve months and whose last sexual partner was a spouse or

regular partner[2]. No question was asked about current marital status. Therefore, only individuals who identified their last sexual partner as their spouse or regular partner could be included in this analysis.

All individuals resided in Khayelitsha at the time of the survey and would be classified as African/black under former apartheid racial classifications. Of the 536 study participants, 410 reported at that their last sexual encounter was with a spouse or "loved one" and occurred in the last 12 months. The following selected characteristics pertain to the 410 sexually active interviewees. 47% were males and 53% were females and ranged in age from 16 to 72, with a median age of 37. Nearly all (n=400) interviews were conducted in the respondents' first language, isiXhosa. Approximately 38% were unemployed at the time of the interview. Nearly all (n=397) had attained some level of education, with 28.3% having completed grade 12. 63% have not ever co-resided with their spouse or regular partner. Additional characteristics of the sample can be found in the Appendix A, Table 1.

Measures

Dependent Variable
The dependent variable is defined as sexually active individuals who were married or in a regular partnership and reported a concurrent sexual partnership in the past twelve months.

Independent Variables
Two categories of independent variables are used for the regression analysis – individual-level and partnership-level. All variables were created using data collected during Wave 3 (2005) of the KPS, unless otherwise noted. The first sets of variables are individual-level variables and include: sex, age, education, income, religious identification, religiosity[3], and community participation. The second set of independent variables relates to partnership-level characteristics and includes: partner's concurrency, co-residence with a spouse or loved one, and condom use.

[2] A regular partner for this analysis is defined as "someone that you love, but are not married to". Of the sexually active participants, 243 identified their last partner as a regular partner.
[3] In this analysis, the religiosity variable was created using questions related to the frequency of participation in religious activities. Individuals who attended religious services or meetings more than once per month were considered as being "high religiosity".

Analysis

Descriptive statistics were used to describe the background characteristics and distribution of variables among the sample population that was sexually active and described their last sexual partner as their spouse or a regular partner; see Appendix A, Table 1. The original sample weights from the 2000 KMP Survey were not used in this analysis because the weights were designed to account for sampling methods based on racial classification. Since this analysis focuses only on the black African population, weighting was not necessary. The sample population is representative of Khayelitsha residents.

Univariate logistic regression was used to examine associations between reported self-concurrency and the independent variables. Unadjusted odds ratios and their 95% confidence intervals are presented and were tested for significance using the Wald Test; see Appendix A, Table 2.

Multivariate logistic regression was then used to assess the relationships between self concurrency, the independent variables, and possible interactions between relevant independent variables; see Appendix A, Table 3. Model 1 of the multivariate models is a full model with all main effects variables included, regardless of their significance in the univariate analyses. Model 2 is a reduced model that used two criteria for inclusion: variables that were significant at the $p \leq 0.20$ level in the univariate analyses or were theoretically important or relevant for resolving an underlying hypothesis. Models 1 and 2 did not include any interaction variables. Interactions between all variables that were theoretically plausible were tested. Two interactions were found to be significant ($p \leq 0.05$). Model 3 is an interaction model that includes all significant variables from Model 2 as well as the two significant and theoretically plausible interaction effects.

Colinearity was first assessed by examining changes in the standard errors. Additionally, measures of tolerance and variance inflation factors (VIF) were examined. Hosmer-Lemeshow goodness-of-fit tests were conducted for all of the models. The area under the receiver operator characteristic (ROC) curve was calculated to determine each model's ability to discriminate between individuals who reported concurrency and those who did not (Hosmer and Lemeshow, 2000). The analyses were conducted using Stata v9.2 (StataCorp LP, 2007).

Ethical Considerations

Each wave of the Khayelitsha Panel Survey received ethical approval from the Centre for Social Science Research Ethics Committee at the University of Cape Town, South Africa. Informed written consent was sought from each individual at the initiation of each survey round. The analysis presented here was exempted from Institutional Review by the Harvard School of Public Health's Human Subject's Committee.

Results

In total, 16.8% (n=69) of individuals in spousal or regular partnerships reported having at least one concurrent sexual partnership in the past twelve months. In the univariate analysis, women were 40% less likely to report concurrency compared to men (OR=0.58, 95%CI: 0.35-0.98). Compared to individuals aged 24 and under, older adults were less likely to report concurrency, though not significantly. Both education and income were not significantly correlated with reported concurrency, with similar numbers reporting concurrency in each of the defined categories. While religion was not correlated with reporting concurrency when the comparison group was missionary-founded religions, religiosity was highly and significantly correlated. Individuals who were more religious were nearly 60% less likely to report concurrency (OR=0.39, 95% CI: 0.23-0.65). Those who were less engaged in community activities were not significantly more likely to report concurrency.

In the univariate analysis, among the partnership-level variables, individuals who reported that their partner had concurrent partners were 12 times more likely to report concurrency (OR=12.28, 95% CI: 6.80-22.20). Individuals co-residing with their spouse or "loved" partner were 40% less likely to report concurrency than those who do not co-reside, though this was not significant (OR=0.62, 95% CI: 0.37-1.05). Though not significant, individuals reporting inconsistent condom use were more likely to report concurrent partners (OR=1.42, 95% CI: 0.59-3.43), while those who report never using condoms were less likely to report concurrency than those reporting consistent condom use (OR=0.84, 95% CI: 0.43-1.66).

In the multivariate analysis, in models without interactions (Model 1 and 2), partner's concurrency status and gender were significantly correlated with reporting having had at least one concurrent partner in the past twelve months.

Women reported concurrency over 50% less than men. Individuals who knew their partners had concurrent partners were more likely to report concurrent partners. In Model 2, religiosity was also found to be correlated with reported concurrency, with more religious individuals reporting less concurrency than less religious individuals (adj.OR=0.49, 95% CI: 0.26-0.94). Education, religion, community involvement, and condom use were not significant in the univariate analyses and so were excluded from Model 2.

In Model 3, two interaction terms were introduced: co-residence with a spouse or regular partner and community involvement and religiosity and partner's reported concurrency. The interaction terms were created on an additive scale, using the two variables (Aschengrau and Seage, 2008). For instance, the interaction term for religiosity and partner's concurrency was operationalized by creating a four-category variable: low religiosity and no reported partner's concurrency (reference), high religiosity and reported partner's concurrency, high religiosity and no reported partner's concurrency and low religiosity and reported partner's concurrency. The interaction term for co-residence and community involvement was also created using a four-category variable: no co-residence and low community involvement (reference group), co-residence and high community involvement, co-residence and low community involvement, and finally, no co-residence and high community involvement.

In Model 3, all categories of the interaction term between religiosity and reported partner's concurrency were significant. In examining the relationship between concurrency and religiosity, stratified by reported partner's concurrency, it was found that religiosity was significantly correlated with concurrency among individuals who reported that their partners did not have concurrent partners (OR=0.23, 95% CI: 0.10 - 0.53, p=0.001). Highly religious individuals who reported that their partner did not have concurrent partners were nearly 80% less likely to report concurrency. However, among individuals who did report that their partners had concurrent partners, religiosity was not correlated with concurrency (OR=0.80, 95% CI: 0.32 – 1.97 p=0.623) (Analysis not shown). The difference between the unstratified odds ratio (OR=0.39) and the differences between the strata indicate that partner's concurrency is both a confounder and an effect measure modifier in the relationship between concurrency and religiosity. This relationship is also evident in the categorical interaction term from Model 3. For instance, compared to having low religiosity and reporting that a partner does not have concurrent partners, individuals with high religiosity and who report that a partner does not have concurrent partners were nearly 70% less likely to report concurrency (OR=0.28, 95% CI: 0.12-0.68,

p=0.01). Compared to the same reference group, individuals reporting a partner who has concurrent partners are approximately seven times more likely to report concurrency, whether they report high or low religiosity (OR=7.79, 95% CI: 3.09-19.61, *p*=0.00 and OR=6.88, 95% CI: 2.91-16.31, *p*=0.00). Assessing the presence of effect measure modification by comparison of the excess relative risk also leads to the same conclusions.

The second interaction between community involvement and co-residence was less evident than the previous interaction. In Model 3, compared to the reference group – not co-residing and having low community involvement, individuals who co-resided and had low community involvement were 60% less likely to report concurrency (OR=0.37, 95%CI: 0.15-0.95, *p*=0.04). In comparing the reference group to the two other categories, the odds ratios were less than one, but were not significant. In comparing the unadjusted odds ratio for co-residence (OR=0.62, *p*=0.07) to the odds ratios for co-residence, stratified by community involvement (OR=0.29, *p*=0.004 for low community involvement and OR=1.11, *p*=0.796 for high community involvement), heterogeneity of the odds ratios were observed. This suggests that the effect of community involvement depends on co-residence with a spouse or regular partner (or vice-versa). Additionally, since the unadjusted odds ratio is noticeably different than the stratum-specific odds ratios, community involvement may also be confounding the relationship between concurrency and co-residence.

The final model (Model 3) is as follows:

$$Logit\left[P_{concurrency}/(1-P_{concurrency})\right] = \beta_0 + \beta_1(gender) + \beta_6(co-residence * community\ involvement) + \beta_7(religiosity * partner's concurrency)$$

The *p*-values for the Hosmer-Lemeshow goodness-of-fit test was 0.19 for Model 1, 0.39 for Model 2, and 0.69 for Model 3, indicating that all the models fit the data well. The area under the ROC curve was 0.837, 0.830, and 0.840 for Models 1, 2, and 3, respectively. All models were able to discriminate extremely well between individuals reporting concurrency and those not reporting concurrency, with the final model (3) being best. The likelihood ratio test comparing Models 1 and 2 and Models 1 and 3 were both significant (*p*-value=0.0001 and *p*-value=0.0168), indicating that Model 2 and Model 3 were not necessarily better fits than Model 1. However, given the small number of outcomes, Model 1 is most likely over-fitted compared to Models 2 and 3, since 10 independent variables were used.

Collinearity in Model 3 was assessed in several ways. Standard errors for the coefficients were not very large or inflated, suggesting little or no collinearity between variables. The variance inflation factor for the variables ranged from 1.17-4.21 and the tolerance ranged from 0.237-0.8516, further suggesting that there was little collinearity between the variables in this model. Overall, the post-estimation tests indicate that the models fit the data well.

Discussion

This analysis has examined correlates of reporting concurrent sexual partners among a population living in Khayelitsha, South Africa. Overall, about 17% of sexually active respondents in married or regular partnerships reported having a concurrent partnership. This estimate is lower than has been found in qualitative research, which suggests frequency of concurrency among adults in Khayelitsha is closer to 50% or higher (Data unpublished). 17% is most likely a conservative estimate of the frequency of concurrency among those who are sexually active, since those in non-regular partnerships may engage in more concurrent partnerships. Additionally, social desirability bias may result in under-reporting (Dare and Cleland, 1994, Fenton et al., 2001). However, having 17% individuals engaged in concurrent partnerships may be sufficient to maintain connected sexual networks, which would allow for the sustained transmission of HIV though this population, particularly when accompanied by other enabling proximal and distal risk factors.

The findings in this study are generally consistent with findings from other quantitative studies in the southern Africa region, including a similar study in Botswana (Carter et al., 2007). Males tend to report having concurrent partners more frequently than females. This could be an artefact of response bias, which generally occurs in self-reports of sexual behaviors (Fenton et al., 2001). However, other literature and qualitative studies suggest that males typically engage in more concurrent partnerships than females, though both genders have concurrent partnerships. It is important to note that while women are statistically less likely to report a concurrent partner, approximately 13% of the women in this population did report a concurrent partner. Concurrency should not therefore be viewed as a male phenomenon. Logically, in order for the sexual networks to remain connected and compatible with continued propagation of HIV, both men and women must be engaged in concurrent partnerships (Morris and Kretzschmar, 2000).

Although the economic aspect of sexual partnerships in South Africa has been well documented, this analysis did not find monthly income to be a significant correlate of engaging in concurrent partnerships, even after adjusting for potential confounding by gender. The interaction between income and sexual partnerships is complex. Among women, income may not be correlated because of what Leclerc-Madlala (2003) refers to as the "continuum of 'needs'". Women, in part, engage in sexual partnerships to satisfy not only material needs but also "wants", which are not necessarily determined by income. These "wants" and "needs" which lead to engaging in concurrent partnerships, together, may be independent of income.

Among men, the role of income as a determinant of having concurrent partnerships may be outweighed by other factors. For instance, men even in lower income brackets may engage in concurrent partnerships, despite the costs, to enhance their social standing among peers. In Kenya, Luke (2005) found that in order to maintain multiple non-married partnerships, poorer men spend a larger proportion of their monthly wages than wealthier men (15% versus 7%). Therefore, while income and transactional elements are critical for maintaining concurrent partnerships, the relationship may not be directly observable in the current analysis.

The role of and interactions between religion, religiosity, sexual partnering practices and HIV risk is critical among a population where over 90% identify with a particular religion and over 85% of those attend religious services or activities on a regular basis. This analysis found that identification with a particular religion is not correlated with reporting concurrent partners. Previous research, however, has suggested that religion, namely Pentecostal churches is associated with a reduction in the extra- and pre-marital sex (Garner, 1999).

Religiosity was highly correlated with reporting concurrent partners. Religiosity in sociological and other literature contains multiple domains, including participation in religious services and activities, frequency of prayer, centrality of personal beliefs or ideology, and consequential influence of religion on daily life (Rohrbaugh and Jessor, 1975). The construction of religiosity in this analysis was limited to participation in religious activities. It is therefore possible that individuals who are highly religious, but who do not attend religious services or events were mis-categorized. This is unlikely to have had a significant impact on the results, since attendance at religious events is a central part of most of the religions that were identified by respondents in this survey.

The construction of this variable may not be appropriate for adherents to other religions where a place of worship does not play a central and significant role.

The lack of association between religion and concurrency may in part be due to the artificial grouping of religions used in this analysis. Another explanation is that it is not a particular religious doctrine that impacts sexual partnering practices, but rather the social values that most religions espouse and are imparted to individuals. These social morals and values are captured in religiosity. Therefore, a more religious individual, regardless of their religion, will have more conservative sexual partnering practices. That varying levels of community involvement did not influence reporting of concurrency, while involvement in churches or religious organizations did influence reporting suggests that it is the social or moral standing of the organization and its teachings that is critical for impacting sexual behaviors.

The findings here are similar to other studies not only in South Africa, but in other countries as well (Kelly and Vencatachellum, 2003, Nicholas and Durrheim, 1995, Rohrbaugh and Jessor, 1975). A study among young South Africans (age 15-24 years) found that a majority of youth reported high religiousness (i.e. reporting that religion was important in their daily life and reporting attending religious services once a week or more), which was protective against ever having sex (Zantsi et al., 2004).

In an examination of religion, religiosity and AIDS in South Africa, Garner (2000) identifies four elements of religiosity that play a critical role in HIV risk behaviors (namely engaging in pre- and extra-marital sex). The four elements are: indoctrination (used without pejorative overtones), describing the methods and depth of a group's educational program; religious/subjective experience, describing the strength of subjective experience, manifested by the level of participation in meetings; exclusion, describing the boundary the group perceives between its members and society at large; and socialization, describing how the group creates and maintains the discontinuity. Garner finds that in South Africa, Pentecostal churches maintain the highest or most extreme level of all four elements, compared to other churches and religious groups. This is associated with having fewer pre- and extra-marital sex partners. Garner's findings as well as the findings from this analysis related to religiosity may have limited impact in relation to HIV prevention interventions. Garner (2000) writes:

> 'These findings may be of only limited value to those addressing the [HIV/AIDS] crisis enveloping South Africa. One paradox of the

> mechanisms by which Pentecostalism and other dynamic groups achieve their effects is that these mechanisms are impossible to replicate.'

The association between religiosity, specifically the high levels associated with Pentecostalism, cannot be easily modified to design or improve HIV prevention interventions.

The potential influence of religion and religiosity can be viewed positively or negatively in its ability to impact HIV prevention. If coherent and accurate knowledge and/or messages related to partner reduction can be delivered, it could impact sexual behaviors. Contrastingly, negative or inconsistent messages could act as an impediment to overall HIV prevention efforts.

The interaction between religiosity and knowledge about a partner's concurrency status suggests that knowledge about a partner's status is of primary importance in having concurrent partners, with religiosity playing a secondary, but still major role, though causality could not be determined in this analysis. Religiosity has a very strong correlation in a negative direction among people who did not report that their partner's had concurrent partners. However, the impact of religiosity among individuals reporting that their partner had concurrent partners is smaller. Therefore, religiosity can potentially play an important role in reducing the number of concurrent partnerships within a community, given the caveats mentioned above.

The finding that among respondents whose partners have concurrent partners, more religious individuals reported more self concurrency (OR=7.79) than less religious individuals (OR=6.88) seems counter-intuitive. One would expect that religiosity would function in the same direction regardless of partner's concurrency status. In part due to the small number of cases in each category, the difference between the two groups was not statistically significant. (Analysis not shown; p=0.24). Though the difference is not significant, the finding suggests that the impact of religiosity is a true relationship, rather than one based on reporting bias. For instance, the effect of religiosity on reporting concurrency could be that more religious individuals are less likely to report concurrent partners or any other sexual practice than less religious individuals. This reporting bias could be used to explain the observed relationship among individuals whose partners did not have concurrent partners. However, since the relationship between religiosity and concurrency is reversed among individuals

reporting that their partner had other partners, it is highly unlikely that the correlation with religiosity is an artefact of reporting bias.

In every model in this analysis, an individual's spouse or regular partner's concurrency status was highly correlated with that individual's likelihood of participating in concurrent partnerships. Individuals who knew their partner had other partners were more than five times more likely to report having concurrent partners, independent of the effect of religiosity. This finding is important for understanding the relationship between partnership stability and sexual risk behaviors. Individuals who know that their partners are not sexually exclusive may be more likely to have other partnerships and may engage in higher risk behaviors. This correlation also indicates that the phenomenon of concurrency may be self-perpetuating in communities where it is common, such as those in South Africa. As more individuals engage in concurrent partnerships, fewer relationships are "monogamous", leading to unstable relationships and additional concurrent partnerships. Concurrent partnerships may not be the causal factor of instability, but they can play a role.

If partnership stability or strength is measured through mutual sexual exclusivity and co-residence, these two factors appear to be highly protective for not engaging in concurrent partnerships. Combined with the non-significant correlation with condom use, this analysis adds further credence to calls for HIV prevention to focus on behavior change related to partner reduction and sexual exclusivity. However, such interventions will need to consider the social and economic factors affecting migration and co-residence.

The highly correlated relationship between one's own concurrency and a partner's concurrency also has important implications for understanding the role of concurrency in HIV transmission dynamics. Morris points out that concurrency poses a risk not for the person engaged in concurrent partnerships, but his partners. Though the person engaged in concurrent partnerships is still at risk because he has multiple partners, the impact of concurrency poses a risk for his partners. Morris writes, "It is relatively easy to see this in the simple case of monogamous women whose male partners have other partners. The men's concurrency here puts their monogamous female partners at risk" (2001). However, this analysis has found a high correlation between one's own concurrency and partner's concurrency, which indicates that one's own concurrency could be an important risk factor for HIV infection above and beyond the risk of having multiple partners in this population.

Overall, this analysis found a moderate level of concurrency among the population. Knowledge that a partner was engaged in other concurrent partnerships and religiosity were both highly correlated with concurrency. Religious and faith communities can play a role in disseminating messages and potentially in effecting sexual behavior change. Promoting sexual exclusivity or serial partnerships will be an important prevention message because of its effects at the individual level (e.g. lower personal risk) as well as at the population-level (e.g. fewer connections in a sexual network).

Limitations & Strengths

There are several limitations to this study that bear mentioning. First, all of the data are self-reported. Previous research has indicated that several biases are evident in self-reported sexual behavior data, including social desirability bias. For instance, men typically tend to over-report their sexual experiences (e.g. exaggerate the number of sexual partners); whereas women tend to under-report their sexual experiences (Lewis, 2000). However, since the trends associated with this bias are generally well known, the direction of their effect can be reasonably assumed.

The survey design limits how the dependent variable can be defined and therefore results in an underestimation of the prevalence of concurrency. Since marital status is not known independently of marital status to the last person the respondent had sex with, some individuals could have been married or in a "loving" relationship and the survey would not have captured that status. This would result in an underestimation of concurrency among respondents in married or "loving" relationships.

There are several strengths to this analysis. Given that numerous qualitative studies have suggested that concurrent partnerships exist in many sub-populations in South Africa, it is critical to characterize them more quantitatively. Few published studies have attempted to quantify and describe such partnerships or the individuals engaged in concurrent partnerships in South Africa. A major strength of this analysis is that it provides a profile of individuals engaged in concurrency in a high HIV prevalence community in South Africa. Another strength of this analysis is that the sample is relatively large and is population-based, so that inferences can be drawn to the larger black township population.

Conclusion

Concurrent sexual partnerships are a critical element of sexual risk behaviors associated with HIV transmission. Given the moderate frequency of these partnerships and social norms that support such behaviors in this population, HIV interventions efforts should begin to target them in order to best prevent transmission. Future research can begin the difficult task of understanding how to best modify this sexual behavior and other high risk behaviors that will potentially require widespread changes in social norms.

Appendix A

Table 1. Percentages distribution of sexually active respondents in married or regular partnerships for selected characteristics.

Variable Description	Total n	%
Concurrency Status	410	
Did not report concurrent partnership		83.1
Reported concurrent partnership		16.9
Sex	410	
Male		46.8
Female		53.2
Age Groups	410	
≤24 years		8.1
25-34 years		35.6
35-44 years		30.0
≥45 years		26.3
Education	410	
Grades 0-8		35.0
Grades 9-12		65.0
Monthly Income (in Rand)	410	
0		37.6
1 - 1 600		39.8
1 600 +		22.7
Religion	395	
Mainline Christian		52.4
AIC[#], Zion, Independent		30.9
Other affiliation		9.4
No religious affiliation		7.3
Religiosity	408	
Low		38.0
High		62.0
Community Involvement	406	
Low		49.0
High		51.0
Spouse's/Regular Partner's Concurrency Status	407	
Partner did not have concurrent partners		81.1
Partner did have concurrent partners		18.9
Co-Residence with Spouse/Regular Partner	410	
Do not co-reside		36.8
Does co-reside		63.2
Condom Use with Spouse/Regular Partner	409	
Never Use		69.7
Consistent Use		17.9
Inconsistent Use		12.5

- AIC = African independent churches

Table 2. Percentage of sexually active respondents in spousal or regular partnerships reporting concurrency, odds ratios, 95% confidence intervals and p-values from univariate analyses.

		Univariate			
Variable Description	%	OR	(95% CI)		*p* value
Total (n=410)	16.8	N/A	N/A		N/A
Sex (n=410)					
Male	20.8	1.00			
Female	13.3	0.58	0.35	0.98	**0.04**
Age (n=410)					
≤24 years	24.2	1.00			
25-34 years	17.1	0.65	0.26	1.60	0.34
35-44 years	18.7	0.72	0.29	1.80	0.48
≥45 years	12.0	0.43	0.16	1.14	0.09
Education (n=403)					
Grades 0-8	17.0	1.00			
Grades 9-12	16.8	0.98	0.57	1.71	0.95
Monthly Income (in Rand) (n=410)					
0	16.2	1.00			
1 - 1 600	16.6	1.02	0.57	1.86	0.94
1 600 +	18.3	1.15	0.59	2.27	0.68
Religion (n=395)					
Mainline Christian	16.4	1.00			
AIC[#], Zion, Independent	18.0	1.12	0.62	2.02	0.71
Other affiliation	16.2	0.98	0.38	2.54	0.98
No religious affiliation	6.9	0.38	0.09	1.66	0.20
Religiosity (n=408)					
Low	25.2	1.00			
High	11.5	0.39	0.23	0.65	**0.00**
Community Involvement (n=406)					
Low	16.5	1.00			
High	17.8	1.10	0.65	1.85	0.73
Spouse/ Regular Partner's Concurrency Status (n=407)					
Partner did not have concurrent partners	8.5	1.00			
Partner did have concurrent partners	53.3	12.28	6.80	22.20	**0.00**
Co-Residence with Spouse/ Regular Partner (n=410)					
Do not co-reside	21.2	1.00			
Does co-reside	14.3	0.62	0.37	1.05	0.07
Condom Use with Spouse/ Regular Partner (n=409)					
Never Use	15.4	1.00			
Consistently Use	17.8	1.19	0.60	2.34	0.62
Inconsistently Use	23.5	1.69	0.82	3.47	0.16

a. All *p*- values are based on the Wald statistic

b. N/A = not applicable

- AIC = African independent churches

Table 3. Odds ratios, 95% confidence intervals and p-values from multivariate analyses.

	Multivariate											
	Model 1				Model 2				Model 3			
Variable Description	OR	(95% CI)		*p* value	OR	(95% CI)		*p* value	OR	(95% CI)		*p* value
Sex												
Male	1.00				1.00				1.00			
Female	0.39	0.18	0.85	**0.02**	0.45	0.22	0.89	**0.02**	0.50	0.25	1.00	**0.05**
Age												
≤24 years	1.00				1.00							
25-34 years	0.16	0.163	1.97	0.37	0.89	0.29	2.69	0.84				
35-44 years	0.21	0.213	3.39	0.82	1.32	0.40	4.41	0.65				
≥45 years	0.09	0.09	1.83	0.24	0.72	0.20	2.54	0.61				
Education												
Grades 0-8	1.00											
Grades 9-12	0.72	0.32	1.61	0.42								
Monthly Income (in Rand)												
0	1.00				1.00							
1 - 1,600	0.79	0.37	1.71	0.56	0.80	0.39	1.64	0.54				
1 600 +	0.70	0.28	1.76	0.45	0.69	0.30	1.59	0.39				
Religion												
Mainline Christian	1.00											
AIC[#], Zion, Independent	0.91	0.44	1.90	0.81								
Other affiliation	0.98	0.30	3.19	0.98								
No religious affiliation	0.19	0.03	1.05	0.06								
Religiosity												
Low	1.00				1.00							
High	0.54	0.26	1.09	0.09	0.49	0.26	0.94	**0.03**				
Community Involvement												
Low	1.00											
High	1.29	0.65	2.54	0.46								
Spouse/ Regular Partner's Concurrency Status												
Partner did not have concurrent partners	1.00				1.00							
Partner did have concurrent partners	16.13	7.79	33.39	**0.00**	12.91	6.76	24.66	**0.00**				
Co-Residence with Spouse/ Regular Partner												
Do not co-reside	1.00				1.00							
Does co-reside	0.75	0.33	1.70	0.49	0.77	0.38	1.55	0.46				
Condom Use with Spouse/ Regular Partner												
Never Use	1.00											
Consistently Use	0.96	0.35	2.64	0.93								
Inconsistently Use	1.71	0.61	4.78	0.31								
Interaction: Religiosity & Partner's Concurrency												
Low Religiosity/No Parter Concurrency									1.00			
High Religiosity/Yes Partner Concurrency									7.79	3.09	19.61	**0.00**
High Religiosity/No Partner Concurrency									0.28	0.12	0.68	**0.01**
Low Religiosity/Yes Partner Concurrency									6.88	2.91	16.31	**0.00**
Interaction: Co-residence & Community Involvement												
No Coresidence/ Low Community									1.00			
Coresidence/High Community									0.90	0.41	1.94	0.78
Coresidence/Low Community									0.37	0.15	0.95	**0.04**
No Coresidence/High Community									0.49	0.18	1.30	0.15
N	382				405				401			
-2 log likelihood	-125.291				-139.964				-135.382			
Likelihood Ratio Test (*p*-value)*	N/A				0.0001				0.0168			
Area under the ROC Curve	0.8369				0.8295				0.8401			
Hosmer-Lemeshow Goodness-of-fit (*p*-value)	0.1923				0.3884				0.6893			

a. All *p* values are based on the Wald statistic

b. Model 1: Full Model - All individual- and partner-level variables

c. Model 2: Reduced Model, including all individual- and partnership-level variables where p≤0.2 in the univariate analysis or are theoretically relevant

d. Model 3: Interaction Model, using categorical interactions

- AIC = African independent churches

* - Likelihood Ratio Test comparing Model 1 to Models 2, and 3, respectively

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