Sexual Behavior of Ever Users of Contraception and Its Implications in a High Prevalence HIV Population in Northwest Tanzania

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Abstract

Antenatal clinic data from a high prevalence HIV population in Northwest Tanzania describe characteristics of women who have ever used contraceptives by their chosen method. Multivariate logistic regression identifies associations between sexual behavior and contraceptive use. Controlling for relevant sociodemographic characteristics, ever users of condoms were most likely to have multiple partnerships themselves and ever users of injectables were most likely to report their partner having multiple partnerships. Condom users had a significantly higher HIV prevalence that was not explained by the sociodemographic or sexual behavior variables. In high HIV prevalence societies, further family planning emphasis should be placed on consistent use of barrier methods as users of hormonal methods are at greater sexual risk for HIV acquisition than non-users. High levels of HIV prevalence among condom users are probably a result of condom use by women who know, or suspect, they or their partner are already infected.

Introduction

Use of modern contraceptives is low but slowly increasing in much of sub-Saharan Africa. When one in three potential partners as in Botswana or one in nine as in Tanzania is HIV-positive, understanding the association between sexual behavior and contraceptive choice has particularly important repercussions not just for family planning but for disease transmission.

Studies have shown an association between condom use and risky sexual behavior in East Africa (Ahmed et al. 2001; Kapiga 1996; Kapiga et al. 2002; Kiddugavu et al. 2003a), but there is a dearth of literature on an behavioral association between hormonal contraceptives and HIV. As hormonal methods offer no protection from HIV and may indeed increase biological susceptibility to the virus (Anon. 2004; Hicks 1995; Kiddugavu et al. 2003b; Lavreys et al. 2004; vanderLinde 1996), it is increasingly important to understand the relationship between contraceptive method and sexual behavior as well as the motivations and considerations underlying a decision to use a specific contraceptive method.

In this study we examine the characteristics of antenatal clinic (ANC) attendees who have ever used modern contraception in a high prevalence HIV population in Northwest Tanzania. In particular, we look at the relationship between high risk sexual behavior and contraceptive method to explore the determinants and implications of contraceptive decision making. This study is not so ambitious as to try to answer all of these questions; our goal rather is to shed some light on the association between sexual practices, HIV and injectable, pill, and condom use.

Background

For over a decade, researchers have attempted to assess whether there exists a biological relationship between hormonal contraception (in the absence of a barrier method) and HIV infection. Hormonal contraceptives cause thinning of the vaginal epithelium and are associated with cervical ectopy, both of which are hypothesized to aid in the transmission of HIV (Kiddugavu et al. 2003a). Numerous studies, both prospective and cross-sectional, have attempted to assess this relationship but as yet have yielded largely contradictory results (Anon. 2004; Morrison and Best 2004; Stephenson 1998), with some finding a slight increased risk of infection and others finding no relationship.

Despite providing a barrier from HIV infection, reported condom use was found to have no overall protective effect against HIV in studies in Tanzania (Kapiga et al. 1998) and Uganda (Ahmed et al. 2001; Kiddugavu et al. 2003a) because of high levels of inconsistent use. A study among commercial sex workers in Zaire found an increased risk of HIV incidence associated with inconsistent condom use (Laga et al. 1994), though other studies showed no significant association between HIV and condom use after adjusting for socioeconomic and sexual behavior (Kiddugavu et al. 2003a). Consistent condom use, however, has been found to be protective against HIV in the general population and not just in high risk populations (Ahmed et al. 2001).

Mwanza Region

The study site covers two districts in the Mwanza Region of Northwest Tanzania. The Mwanza district is located along the Kenyan border and includes Mwanza, the second largest city in Tanzania. In contrast, the neighboring Magu district, located along Lake Victoria, is predominately rural. Previous HIV-related research had been done in the region for over a decade, including an ongoing community-based study in the Kisesa ward within Magu district (see Boerma et al., 1999 for details).

Antenatal clinic attendance in much of Tanzania and in the region under study is over 90% (Boerma et al. 1999). Access to family planning service is similar to access to ANCs in the Mwanza Region because most of the ANCs offer family planning services. Additional outlets for contraception include specialized clinics such as Marie Stopes International, local NGOs, and specialized pharmacies. While certain contraceptive methods requiring special training (tubal ligation, Norplant and IUD) are not universally available, the three most common modern contraceptives: condoms, pills and injectables, are generally available at all providers. Urban women have greater access to health centers and hospitals and thus to tubal ligation, Norplant, and IUDs. However, for more commonly used dispensary methods, mobile clinics provide rural residents with similar contraceptive access as urban residents.

Use of modern contraceptives is rising in Tanzania. Data from successive Tanzania Reproductive and Child Health Surveys show an increase in ever use of modern contraceptives from 14% in 1991-2 to 30% in 1999. The most common methods ever used in 1999 were oral contraceptives (16%), injectables (12%), and male condoms (11%). In 1999, 16% of reproductive age women responded that they were currently using modern contraception. The most common methods were injectables (5%), oral

contraceptives (5%) and male condoms (4%). The largest increase in contraceptive use during the decade was with injectables, which rose from current use of just 1% of all women in 1991-2 to 5% in 1999 (National Bureau of Statistics [Tanzania] and Macro International Inc. 2000).

As elsewhere in Tanzania, HIV prevalence in Mwanza Region varies greatly by residence (Boerma et al. 1999; Measure, National AIDS Control Program and Bureau of Statistics 2001). Prevalence in Mwanza City was estimated to be fairly stable at 12% between 1989 and 1995. In 1991, roadside settlements and trading centers were estimated to have somewhat lower levels of infection (7-12%), while rural areas had half the prevalence (5%) (Measure, National AIDS Control Program and Bureau of Statistics 2001).

In this study, we hypothesize that women who have used contraception will have riskier sexual behavior than sexually active women who have not used contraception. For this study, we define risky sexual behavior as having multiple partners or having a partner who has multiple partners. In particular, we anticipate the riskiest sexual behavior to be practiced in women who have used condoms because of associations found in the sub-region between condom use and nonmarital partnerships and condom use and frequency of partner exchange (Ahmed et al. 2001; Kapiga 1996; Kapiga et al. 2002; Kiddugavu et al. 2003a). We consequently expect HIV levels to be highest among these women because of inconsistent use of condoms.

We expect women who have used hormonal methods to have riskier sexual behavior than non-users. Women using hormonal contraception are sexually active and trying not to have children. For young Tanzanian women, use of hormonal methods will likely reflect a desire to space childbearing, and thus be closely related to parity. However, use of hormonal methods may also reflect a resistance to having children with a particular partner. This may be due to an unstable sexual relationship or to an effort to not create an orphan due to an awareness or suspicion of her or her partner's HIV status. As a result, we expect HIV prevalence to be higher among injectable and pill users than women who have never used these methods.

Data and Methods

Our analysis uses cross-sectional data from the Mwanza Region of Northwest Tanzania. The data were collected over two three-month periods in 2000-1 and 2001-2 at 11 antenatal clinics in Mwanza and Magu districts. Pregnant women attending a participating ANC for the first time during one of the three month periods were recruited for the study. A structured interview was administered in Swahili that covered sociodemographic characteristics, sexual behavior, and reproductive history. With the participant's consent, blood samples regularly taken for antenatal syphilis screening were additionally used to test for HIV (see Urassa et al. forthcoming for a full description of the study).

Studying the contraceptive history of pregnant women from ANC data has inherent limitations, the ramifications of which will be explored later. However, the data are nonetheless informative because they permit an analysis of the relationship between

sexual behavior, ever use of contraception and HIV status (using a biomarker) in a large sample controlling for sociodemographic characteristics. The data also focus analyses on sexually active women, our population of interest. Women in the study who report never having used modern contraception are confirmed as sexually active women and in analyzing levels of HIV infection are a better comparison group for women who have used contraceptives.

Description of variables

Outcomes of interest in the study were ever use of contraception, ever use of injectable contraception, ever use of oral contraceptives (pills), ever use of male condoms and HIV infection.

The key explanatory variables were mother's sexual behavior in the last year and father's sexual behavior in the last year. Mother's sexual behavior in the last year was divided into four categories that incorporated the effects of multiple partnerships and non-marital partnerships. The categories were 1 marital partner (baseline), 1 non-marital partner, 2 partners, and 3 or more partners. Father's sexual behavior in the last year was based on mother's reporting of his sexual partnerships. It was divided into three categories: no other partner, 2 or more partners and does not know.

Covariates included age, premarital sexual exposure (age married or age of interview – age at sexual debut) and years since marriage (age interview – age married) as continuous variables. Current urban residence, previous urban residence, education, parity, religion and marital status were investigated for their role as confounding variables. Marital status was categorized as either monogamous married (baseline for odds ratio comparisons), polygamous married, never married or ex-married. Cohabiters (2.2% of all women) were classified as monogamously married because they were found to have similar sociodemographic and sexual behavior characteristics to married women. The addition of a separate classification for polygamous marriages provides a control for the different sexual characteristics of polygamously married women by definition (e.g. partner's additional partners).

We discuss patterns in ever use of contraception and HIV infection in all women but limit our analyses of the association between sexual behavior, contraceptive use and HIV to women under 25 years of age. Ever use of contraception for women under 25 is likely to be more relevant to recent sexual behavior. Similarly, HIV seroconversion is more likely to have occurred recently in younger women and therefore will be more closely related to sexual behavior in the past year.

All statistical analyses were done using Stata 8.2 (Stata Corporation, College Station, Texas, USA). Chi-squared tests were performed to detect significant differences in sociodemographic characteristics and sexual behavior between users of contraceptives and non-users. For continuous variables, two sample t tests with equal variances were used to detect significant differences between means. Multivariate logistic regression models were used to identify sexual predictors of ever use of a specific modern

contraceptive method. A separate multivariate model was constructed with HIV as a dependent variable to investigate associations between contraceptive method and

Table 1: Characteristics of ANC (% of total) attendees in Northwest Tanzania

	All women	<25 years old	≥25 years old
Number	100.0 N=7,032	100.0 N=3,689	100.0 N=3,343
Clinic site			
Rural	20.0	19.1	20.9
Roadside	29.7	28.3	31.3
Town	18.2	17.8	18.6
City	32.2	34.9	29.2
Age			
<20	19.2	36.7	-
20-24	33.2	63.4	-
25-29	25.0	-	52.6
30-34	13.0	-	27.3
≥35	9.5	-	20.1
Current residence			
Rural	61.2	58.0	64.6
Urban	38.9	42.0	35.4
Occupation			
Subsistence agriculture	68.3	64.5	72.4
Other	31.7	35.5	27.6
Marital status			
Never married	17.8	24.4	10.5
Married (monogamous)	67.8	66.7	69.6
Married (polygamous)	11.5	7.2	15.4
Ex-married	3.0	1.7	4.6
Parity			
Expecting 1st child	24.4	43.9	2.9
Expecting 2nd-3rd child	36.0	48.8	21.8
Expecting 4th-5th child	22.1	7.1	38.6
Expecting >5th child	17.6	0.2	36.7
Education			
None	17.6	14.9	20.6
Incomplete primary	20.2	20.8	19.4
Completed primary	57.1	59.5	54.5
Some secondary	5.2	4.9	5.5
Mother's partners last year			
1 marital partner	76.0	70.2	82.5
1 non-marital partner	17.0	20.7	13.0
2 partners	4.4	5.4	3.2
≥3 partners	2.6	3.7	1.3
Father's partners last year			
1 partner	35.5	42.5	27.9
≥2 partners	26.6	21.1	32.7
Do not know	37.8	36.4	39.4
HIV/STD			

Positive HIV	10.7	10.2	11.3
Positive syphilis	14.6	14.3	15.0
Contraception (ever use)	All women	<25 years old	≥25 years old
Any modern method	24.7	21.6	28.1
Condom	12.5	14.8	10.0
Injectable	8.6	4.6	13.1
Pill	7.5	5.1	10.2
Sexual exposure	Mean (SD)		
Years of premarital sex	2.54 (3.78)	1.74 (1.93)	3.43 (4.95)
Years since 1st marriage	5.48 (6.02)	1.93 (2.07)	9.40 (6.50)
Years since sexual debut	8.02 (6.04)	3.66 (2.24)	12.82 (5.21)

infection. All models accounted for the clustered design of the study using individual three month periods at each clinic as the primary sampling units.

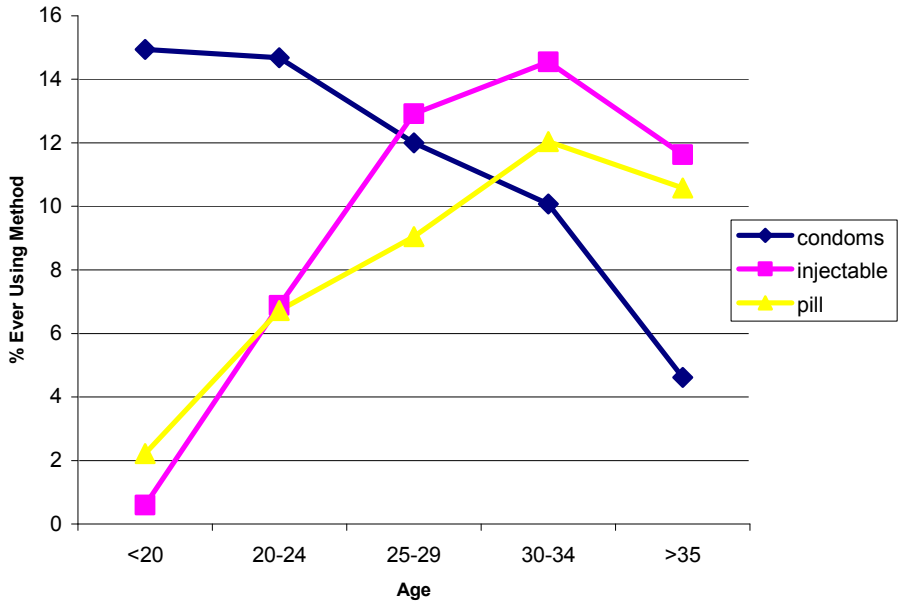
Results

The ANC project collected data on 7,032 women, 3,689 women under 25 and 3,343 women 25 and over. Table 1 presents the sociodemographic and sexual behavior characteristics of the women in the study population by age group.

A quarter of the study population had ever used modern contraceptives, 12.5% had used condoms, 8.6% injectables and 7.5% oral contraceptives. A small number of women, and very few women under 25, had used the loop, norplant or foam. Some women had used two or more forms of modern contraception. Of the 796 women under 25 who had ever used modern contraception, 40 (5.0%) used both injectables and condoms, 14 (1.8%) had used both injectables and the pill, 45 (5.6%) had used both the pill and condoms and 7 (0.9%) had used all three methods. These women will be considered in the independent analyses for each method used.

Women under 25 were more likely to have used condoms while women over 25 were more likely to have used a hormonal method (Figure 1). Ever use of injectable and pill followed similar trajectories: limited use in younger ages with accumulated use peaking in the 30-34 age group. Ever use of condom, however, followed a noticeably different trend. Here, use was highest in young women and fell consistently—despite being a cumulative measurement—with age.

Figure 1: Accumulated use of modern contraceptives



Women under 25 years of age

The ever use of contraceptive methods varied in women under 25 by social, demographic and sexual characteristics (Table 2). Teenagers were as likely as women in their early twenties to have ever used condoms, whereas use of hormonal methods did not begin until later. Urban women were almost twice as likely to have used any form of modern contraception, with the largest differential existing for injectable use. Ever use of hormonal methods increased with parity while accumulated ever use of condoms decreased with parity. Formerly married women were the most likely to have used hormonal methods and all unmarried women (never and formerly married) had higher ever use of condoms.

Muslim women were more likely to have used contraceptives than any other religious group. Protestants and Catholics had similar usage and practitioners of traditional religion rarely used modern contraception. However, differences by religion should be interpreted with caution as they may reflect socioeconomic status rather than particular religious beliefs (Goldscheider, 1971; McQuillan, 2004).

Table 2: Sociodemographic characteristics by ever use of contraceptives in women under 25

	Never Users	Ever Users	Condom	Injectable	Pill
Total N=3,689	N=2,893	N=796	N=545	N=169	N=187
	78.4	21.6	14.8	4.6	5.1
Age					
<20	**82.7**	**17.3**	14.9	**0.6**	**2.2**
20-24	**76.0**	**24.1**	14.7	**6.9**	**6.7**
Residence					
Rural	**83.5**	**16.6**	**11.8**	**2.8**	**4.1**
Urban	**71.5**	**28.5**	**17.9**	**7.0**	**6.5**
Religion					
Protestant	**80.6**	**19.4**	**13.7**	**4.1**	**3.8**
Catholic	**76.4**	**23.6**	**16.1**	**4.7**	**6.0**
Muslim	**61.4**	**38.6**	**25.0**	**10.1**	**9.8**
Traditional	**93.6**	**6.4**	**3.9**	**0.9**	**2.1**
Marital status					
Never married	**75.4**	**24.6**	**19.8**	**3.0**	4.3
Married (monogamous)	**79.9**	**20.1**	**12.7**	**4.9**	5.3
Married (polygamous)	**77.0**	**23.0**	**15.5**	**5.3**	4.9
Ex-married	**69.4**	**30.7**	**20.5**	**11.5**	6.4
Education					
None	**87.6**	**12.4**	**8.6**	**2.4**	**2.7**
Incomplete primary	**79.6**	**20.4**	**13.0**	**3.8**	**4.4**
Complete primary	**77.1**	**22.9**	**15.9**	**5.1**	**5.8**
Some secondary	**62.0**	**38.0**	**27.4**	**8.9**	**5.6**
Parity					
Expecting 1st child	**81.9**	**18.1**	**16.9**	**0.5**	**1.4**
Expecting 2nd-3rd child	**74.3**	**25.7**	**13.7**	**7.2**	**7.4**
Expecting >3rd child	**73.6**	**26.4**	**9.3**	**11.5**	**11.5**
Mother's partners last year					
1 marital partner	**80.6**	**19.4**	**12.0**	4.9	5.1
1 non-marital partner	**78.7**	**21.3**	**16.2**	3.3	3.9
2 partners	**64.3**	**35.7**	**28.6**	5.0	8.5
≥3 partners	**35.9**	**44.1**	**39.7**	5.9	5.9
Father's partners last year					
1 partner	**81.1**	**18.9**	**14.0**	**2.7**	**3.9**
≥2 partners	**72.8**	**27.3**	**20.3**	**6.4**	**5.8**
Do not know	**78.6**	**21.4**	**12.5**	**5.7**	**6.0**
HIV					
Positive HIV	**70.1**	**29.9**	**22.9**	5.9	6.1
Negative HIV	**79.4**	**20.6**	**13.9**	4.4	5.0
Syphilis					
Positive syphilis	79.3	20.7	14.8	3.2	4.9
Negative syphilis	78.3	21.7	14.8	4.8	5.1

Percentages in bold represent differences by characteristic significant at p-value <0.05 level of the chi-squared statistic.

Multivariate Analyses

Multivariate logistic regression was used to elucidate the association between certain sexual risk behaviors and ever use of a specific contraceptive method after controlling for relevant sociodemographic characteristics and other sexual behavior. To do this we constructed three multivariate models predicting: (1) ever use of condoms, (2) ever use of injectables, and (3) ever use of the pill. The models included the two independent variables of interest: mother's sexual partners and father's sexual partners, the sociodemographic variables in Table 2 as controls, years of premarital sexual exposure and years married.

Table 3: Adjusted odds ratios (and 95% confidence intervals) for logistic regression models predicting ever use of modern contraceptive methods

	Condom	**Injectable**	**Pill**
	Adjusted OR	Adjusted OR	Adjusted OR
Total N=3,689	N=545	N=169	N=187
Age*	1.04 (0.97, 1.11)	1.08 (0.97, 1.20)	1.01 (0.89, 1.14)
Premarital sexual exposure*	**1.16** (1.08, 1.26)	1.09 (0.95, 1.26)	1.06 (0.95, 1.19)
Marital sexual exposure*	0.98 (0.87, 1.09)	**1.22** (1.03, 1.45)	1.08 (0.96, 1.21)
Residence			
Rural	1	1	1
Urban	1.32 (0.80, 2.18)	**2.56** (1.78, 3.68)	1.39 (0.66, 2.91)
Religion			
Protestant	1	1	1
Catholic	1.13 (0.95, 1.35)	1.05 (0.68, 1.63)	**1.62** (1.22, 2.15)
Muslim	**1.76** (1.15, 2.68)	**1.85** (1.12, 3.06)	**2.52** (2.01, 3.16)
Traditional	**0.34** (0.19, 0.61)	**0.27** (0.11, 0.66)	0.66 (0.24, 1.77)
Marital Status			
Married (monogamous)	1	1	1
Never married	0.67 (0.32, 1.42)	0.72 (0.30, 1.69)	1.63 (0.60, 4.45)
Married (polygamous)	1.02 (0.69, 1.51)	0.88 (0.52, 1.49)	3.16 (1.40, 7.15)
Ex-married	1.36 (0.59, 3.10)	1.13 (0.21, 6.23)	1.96 (0.69, 5.60)
Education			
None	1	1	1
Incomplete primary	**1.48** (1.01, 2.16)	1.29 (0.67, 2.49)	1.50 (0.73, 3.06)
Complete primary	**1.83** (1.20, 2.81)	**1.92** (1.06, 3.46)	2.17 (1.22, 3.86)
Some secondary	**3.02** (1.67, 5.44)	**4.34** (2.10, 8.98)	2.40 (1.21, 4.76)
Parity Group			
Expecting 1st child	1	1	1
Expecting 2nd-3rd child	**0.68** (0.50, 0.93)	**9.93** (5.31, 18.57)	**5.07** (3.56, 7.22)
Expecting >3rd child	**0.45** (0.25, 0.83)	**12.57** (5.63, 28.07)	**8.39** (4.58, 15.38)
Mother's partners last year			
1 marital partner	1	1	1
1 non-marital partner	1.70 (0.63, 4.62)	**2.50** (1.15, 5.44)	1.63 (0.60, 4.45)
2 partners	**3.06** (1.45, 6.47)	**2.46** (1.14, 5.31)	**3.16** (1.40, 7.15)
≥3 partners	**4.60** (2.11, 10.07)	**2.94** (1.34, 6.42)	1.96 (0.69, 5.60)
Father's partners last year			
1 partner	1	1	1
≥2 partners	**1.88** (1.41, 2.50)	**2.02** (1.16, 3.51)	1.24 (0.71, 2.16)
Do not know	1.41 (0.91, 2.19)	**1.99** (1.11, 3.59)	1.53 (0.84, 2.79)

Bold type indicates ORs significant at p-value <0.05 level.
*continuous variables

According to the regression results shown in Table 3, women who had multiple partnerships in the past year were more likely to have ever used each of the three modern contraceptive methods. The association was strongest for condoms where odds of ever using condoms increased with number of reported partnerships and women with three or more partnerships had 4 times the odds of using condoms as women whose only partner was their husband. Women who had any sexual encounter outside of a marriage were more than twice as likely to have used injectables.

The probability of a woman having ever used condoms and injectables increased when she reported her partner having other sexual partners in the past year. Her probability of having ever used injectables also significantly increased when she reported that she did not know about her partner's sexual behavior. All significant associations maintained significance when use of the other methods was controlled for (not shown).

HIV

HIV prevalence was 7.5% among teenagers attending antenatal clinics and 11.5% among 20 to 24 year olds. Levels of infection were higher among women who had ever used modern contraceptives regardless of the method used. The difference in HIV prevalence among women under 25 who had ever used condoms was significantly higher (15.8%) than women who had never used a modern contraceptive (9.1%) and was also significantly higher than women who had used injectables (13.0%) or the pill (12.3%).

Simple multivariate logistic regression models were constructed to examine the controlled association between ever use of contraception and HIV and, in doing so, to attempt to understand the mechanism through which contraceptive use and condom use in particular is associated with HIV. Crude ratios for HIV infection by ever use of contraceptive methods are shown in Table 3 as are adjusted ratios controlling for background prevalence (HIV prevalence by clinic), education, previous urban residence (current residence is controlled for through background prevalence), premarital sexual exposure, years since marriage, mother's sexual behavior, and father's sexual behavior. There remained a significant unexplained increased risk for HIV associated with ever use of condoms (OR: 1.57).

Table 4: Crude and adjusted odds ratios (and 95% confidence intervals) for HIV infection by ever use of contraceptive method

	Crude OR (95% CI)	Adjusted OR (95% CI)*
No method	1	1
Condom	**1.85** (1.30, 2.63)	**1.57** (1.05, 2.34)
Injectable	1.34 (0.90, 2.01)	0.99 (0.68, 1.45)
Pill	1.26 (0.77, 2.04)	1.02 (0.63, 1.64)

*model controls for clinic site, education, marital status, premarital sexual exposure, marital sexual exposure, sexual partnerships and partner's sexual partnerships

Discussion

If condom use had remained static you would expect to see an increase in ever use with age. However, this study found that ever use of condoms peaked in young women and declined by age 25. Such a strong age trend is surprising but may be reasonable given the

recent intense condom messaging in response to high levels of HIV/AIDS in Tanzania (Measure, National AIDS Control Program and Bureau of Statistics 2001; Tanzania Commission For HIV/AIDS 2003). It is possible that older women were more removed from these messages or were more likely to be in stable relationships (where condom use is less common) when the emphasis on condom use began.

The strength of the association between sexual behavior and contraceptive history varied by contraceptive method for women under 25. In general, however, the more partners a woman had, the more likely she was to have used each of main modern methods of contraception. Having multiple partners was a particularly strong predictor of ever use of condoms and injectables. Additionally, women who reported that their partner had other sexual partners, independent of their personal sexual behavior, were more likely to have used condoms and injectables.

The reasons for the strong association found between risky sexual behavior and ever use of injectable contraception cannot be clearly determined in this cross-sectional analysis. It is possible that women with multiple partners are in more unstable relationships and do not want to have children with any of their partners. Women who report that their partner has other partners or that they do not know about their partner's sexual partnerships may also be in less stable relationships, and they may be less powerful than women in stable monogamous relationships. This would correspond with findings from Kenya that injectables are the most common method of contraception among women whose partner disapproves of family planning (Magadi and Curtis 2003). The covert use of contraceptives in Eastern Africa has been demonstrated (Biddlecom and Fapohunda 1998; Rutenberg and Watkins 1997) and may play a role in the relationship revealed in this study between hormonal contraceptives and sexual behavior. Findings for oral contraception were similar to but weaker than those for injectables, which may be due to the greater ease in which a quarterly injection can be hidden compared with a daily pill.

Reverse causality cannot be ruled out but does not detract from the findings. Whether a woman who engages in risky sexual behavior chooses to use modern contraception or a woman who uses contraception feels freer to engage in more risky sexual behavior, the implications for disease transmission and the need for sexual health and family planning programs to complement one another is still great.

The results on injectable contraception are additionally important in the topical debate over the role of injections in the spread of HIV in sub-Saharan Africa (see Gisselquist et al 2003, Gisselquist et al 2004 and Schmid et al 2004 for an introduction to the debate). Women regularly using injectable contraception will have an additional 3 to 4 injections a year solely for contraceptive purposes. These women are also more likely to have multiple partners and/or suspect their partners of having another partner. Use of injectable contraception, and associated sexual behavior, is likely to confound the relationship between number of injections and HIV infection, and if not taken into consideration could lead to a false conclusion about the true epidemiology of HIV transmission.

Furthermore, these findings reinforce the importance of controlling for sexual behavior in studies examining a biological mechanism between hormonal contraceptives (both the injectable and the pill) and HIV transmission because of the observed positive relationship between sexual partnerships and hormonal contraceptive use.

Our findings concur with others in East Africa that condom use can be interpreted as a proxy for multiple sexual partnerships (Bloom et al. 2002), but conflict with a case-control finding of no association between condom use and HIV infection (Quigley et al. 1997). The positive relationship between condom use and HIV infection found in this study persisted after controlling for sociodemographic and sexual risk factors. Since it is unlikely that there is a biological mechanism causing the positive association between ever use of condoms and HIV, the risk associated with condoms might be more complicated than an association with number of sexual partners. We suggest three explanations. First, ever users of condoms are more likely to know or suspect that they or their partners have HIV. Thus, HIV infection is a reason for condom use rather than condom use being an indicator of sexual behavior that led to HIV infection. Reverse causality cannot be ruled out but is not likely to be a large influence since few individuals in this population know their HIV status. Still, many may suspect their HIV positive status particularly if they have partners who are sick or who died recently and may be able to successfully negotiate condom use in certain situations.

Second, condom use might not just be associated with absolute number of partnerships but also with particular types of partnerships. For example, female bar workers or women who have sex with truck drivers (or other high risk males) may have an excess risk for HIV that is associated with the type of encounter. Additionally, women who perceive themselves to be at risk for STDs and HIV are more likely to use condoms (Lutalo et al. 2000); however if they do not use them regularly, there would be an excess risk of HIV attached to ever use of condoms that could not be explained by absolute numbers of partnerships alone.

Third, self-reported sexual behavior data from women is subject to underreporting (Nnko et al. 2004) which could produce misleading results especially if the underreporting or misreporting differs with respect to contraceptive use. Three types of underreporting are likely to have occurred: female underreporting of her own behavior, female reporting of sexual risk behavior in the last year that is less risky than sexual risk behavior occurring at the time of contraceptive use, and not knowing her partner's true sexual risk behavior.

This cross-sectional study is subject to a number of limitations. First, there is the problem of underreporting of sexual behavior discussed above. However, the reported sexual behavior was consistent with that found in Kisesa community-level data and the regressions yielded sensible results: condom use was associated with premarital exposure while hormonal contraceptive use was associated with marital exposure, and the probability of HIV infection increased with reported sexual partnerships.

Second, there are clear limitations associated with studying contraceptive behavior in a pregnant population. Data on ever use of contraception was likely to be months if not

years old. Furthermore, because these women were currently pregnant, contraceptives were most likely used to delay or space pregnancies or to prevent sexually transmitted disease (condoms). In generalizing the conclusions about the broader contracepting population, it is important to acknowledge that characteristics of women who are spacing pregnancies may be different from other sexually active women ceasing childbearing altogether, either because of infecundity or because they are contracepting to prevent further births. This study population would also exclude women who are now sterilized or whose sole partner is sterilized, who are more effective users of contraception and who are temporarily currently sexually inactive.

Third, the cross-sectional nature of this study means that sexual behavior may have changed since the last episode of contraceptive use or since HIV infection. To limit the effect of changes in sexual behavior, this study focused on women under age 25 whose contraceptive history and possible HIV infection would be more recent and relevant to sexual behavior in the past year, thereby narrowing but not removing this potential measurement error.

Fourth, the ANC study did not collect information on other STIs apart from syphilis. Herpes-simplex virus, in particular, which was found in 1 of 3 women under 25 in the region (Obasi et al. 1999), is known to increase transmission of HIV and could not be controlled for as an important cofactor in the relationship between HIV and ever use of condoms.

More research is needed to investigate motivations for contraceptive decision making. This is of particular importance in high prevalence HIV populations where the decision to use a barrier or non-barrier method may be more important than the decision to use or not use family planning. In particular, improving understanding of the circumstances in which condoms are used, when a woman can negotiate condom use and the reasons for the widespread inconsistency of use would aid our understanding of the unexplained HIV risk associated with condom use and would strengthen disease prevention efforts.

The implications of this study, while not without limitation, are valuable. Among sexually active women, those who have used modern contraception have riskier sexual behavior. This behavior differs in extremity and in nature by chosen method. Women who have used condoms are most likely to have multiple sexual partnerships, while women who have used injectables are most likely to report that their partner has multiple sexual partners. Condom users had a higher HIV prevalence that was not explained by sociodemographic or sexual behavior variables and is probably a result of condom use by women who know, or suspect, they or their partner are already infected. The study leaves open the interesting possibility that women with riskier sexual behavior may be able to negotiate condom use and women whose partners have risky behavior may prefer and be able to use more easily concealed contraceptive methods such as injectables.

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