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"Behold, a Virgin is with HIV!": Misreporting Sexual Behaviour Among Infected Adolescents

By

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"Behold, a Virgin is with HIV.":

Misreporting Sexual Behaviour Among Infected Adolescents[1]

Abstract

In four Southern African countries where the HIV prevalence rate is among the highest in the world, 46% of female and 68% of male adolescents infected with HIV report having never engaged in sex. This finding indicates either the dominance of non-sexual modes of HIV transmission or systematic misreporting of sexual behavior in these countries. We use a structural model to estimate the extent of misreporting and find that the true percentages of virgins among the HIV infected adolescent females and males are 23% and 62% respectively. Despite misreporting, sexual modes are not the dominant mode of HIV transmission.

Key words: misclassification, premarital sex, HIV transmission mode, partial observability, sub Saharan Africa

JEL codes: C39,C51,I10,I18,O55.

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"Behold, a Virgin is with HIV.":

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1. Introduction

Sexual behaviors are often subjected to misreporting. In particular, in societies where sexual purity before marriage is highly valued, an unmarried adult seeking a union may not reveal previous sexual activity. In this study, we apply an econometric technique to quantify the extent of misreporting of pre-marital sex of unmarried adults including adolescents of both genders in four Southern African countries where the prevalence rates of HIV/AIDS are among the highest in the world.

The United Nations Development Programme (UNDP) views the HIV epidemic as 'the great reversal in human development inflicted on many countries' during the last two decades (UNDP, 2005). The World Health Organization, reporting a total of 33.4 million people living with HIV worldwide, considers the epidemic as a 'major public health challenge' (WHO, 2010). HIV is widely perceived as a sexually transmitted decease. This view has been endorsed by the majority of researchers (Schmid et al., 2004; Boulos et al., 2006; Herida et al., 2007; Hall et al., 2008). Accordingly, the resources channeled for the prevention of HIV are mostly allocated for the programs that target the sexual mode of transmission.

However, unlike most of the world, in Southern African countries sexual activity may not be the predominant mode by which HIV is transmitted. A sizable fraction of adolescents who have tested positive for HIV self-reports as never having sex (Gavin et al., 2006; Brewer et al., 2007; Deushert, 2011). Yet, there is no consensus among researchers if misreporting leads to this anomaly. Gavin et al. (2006) suspect a high proportion of

misreporting while Brewer et al. (2007) challenge that view. Deushert (2011) highlights the need to quantify the extent of misreporting.

This paper estimates the extent of misreporting of pre-marital sex among unmarried male and female adolescents (15-19 years) in four Southern African countries; Lesotho, Swaziland, Zambia and Zimbabwe. The four countries are among the top 6 countries in terms of adult prevalence of HIV/AIDS. Misreporting is quantified using an econometric approach based on Poirier (1980), Abowd and Farber (1982) and Tennekoon and Rosenman (2010). Our approach helps to identify systematic variations in misreporting across sub-populations, including those who are HIV infected. Thus, this study provides a direct answer to the existing 'HIV-Virgin puzzle' thereby guiding prevention programs on the optimal balance of resource allocation between the programs targeting the sexual behavior and those targeting other potential routes of HIV transmission. The magnitude of misreporting of sexual behavior is useful for other related research and policy decisions. Although a specific application, this study also demonstrates how to overcome the issue of endogenously misclassified data, which may pervade much data, especially that which is self-reported data.

The paper proceeds as follows. In section 2, we discuss the role of sexual modes of HIV/AIDS transmission based on the estimates from published reports and research papers. In section 3, we present selected literature discussing the factors associated with pre-marital sex and the reasons to misreport pre-marital sexual acts. Both of these discussions focus on Africa. In section 4, we present a structural model to identify the determinants of the decision to abstain from or engage with pre-marital sex and the extent

of misreporting of such behavior. In section 5, we present our empirical application. Section 6 offers conclusions and implications.

2. Is HIV predominantly a Sexually Transmitted Disease?

There is little disagreement that HIV is predominantly sexually transmitted in most developed countries. According to the Centers for Disease Control and Prevention, 86% of new HIV cases reported in 2008 were sexually transmitted (CDC, 2010). In Canada, the corresponding estimate is 79% (PHAC, 2009). The predominant mode of transmission varies across different regions of Europe (Herida et al., 2007). In Western and Central European regions sexual mode has been responsible for 91% and 79% of cases respectively. But in Eastern Europe, in contrast, it is estimated that injection drug usage (IDU) causes 62% of HIV cases, while sexual activity only accounts for 37%.

Most population estimates[2] for sub-Saharan African counties also identify sexual transmission as the predominant mode of HIV transmission (Schmid et al. ,2004). The Uganda National AIDS Commission (2009) estimates that 99% of new HIV infections in adults (15-49 years) in Uganda are sexually transmitted. Gouws et al. (2006) estimate the mode of transmission of 95% of new HIV infections in Kenya are sex related while the Kenya National AIDS Control Council estimates the corresponding number as 94% (KNBS, 2010).

[2] These estimates that support sexual transmission as the predominant mode of HIV infection are based on surveillance data and not on random sampling of the general population. Two approaches used widely to estimate the population level characteristics of HIV epidemic are the workbook method (Lyerla et al., 2006) and the EPP method (Ghys, 2004).

More recently, the Demographic and Health Surveys (DHS) funded by the U.S. Agency for International Development (USAID)[3] have raised concerns on the validity of the assumption that HIV in Africa is predominantly transmitted through sexual activity. Analyzing the self-reported DHS data and the HIV test results Gavin et al. (2006) point out that 41% of HIV infected females aged 15-19 years in Zimbabwe identify themselves as virgins. Brewer et al. (2007) document that 44% of HIV positive female adolescents in Kenya, 48% in Lesotho and 56% in Tanzania also self-report as virgins. In case of males the respective numbers are 100% for Kenya, 67% for Lesotho and 73% for Tanzania. Deuchert (2011) shows that HIV prevalence among unmarried adolescent women (age 15-19 years) in Lesotho, Zimbabwe and Swaziland who self-report as virgins is 53%, 33% and 65% respectively.

There have been at least five hypotheses to explain the above anomaly. Creek et al. (2006) suggest four possibilities: data collection or entry errors; having sexual exposures to HIV through an act the respondent do not consider as having sex; not reporting the sexual behavior truthfully and getting infected through a nonsexual route. A fifth explanation is a high number of false positives in HIV testing. Gavin et al. (2006) attribute most of these cases to misreporting in the context of social desirability bias. In a society where the virginity until marriage is highly prized respondents may lie about premarital sex, even in anonymous surveys. Brewer et al. (2007), challenging the view of Gavin et al., highlight other possibilities such as contaminated blood during medical, dental, cosmetic,

[3] The DHS use nationally-representative relatively large (5,000-30,000) household samples to collect comparable data in the areas of population, health, and nutrition in developing countries. The data collection process has been supplemented with volunteer HIV testing of participants in 30 countries since 2001.

or ritualistic procedures. They also suggest the possibility of 'false positive tests'. Deuchert (2011) discusses the exact issue as her main research concern, which she terms as the 'HIV-Virgin puzzle'. Her findings favor the view of Brewer at al. that the magnitude of 'other possibilities' may be larger than the conventional estimates.

From a policy perspective we can categorize the suggested explanations of the observed anomaly into three groups:

(i) Data entry and coding errors and intentional and unintentional misreporting all of which underreport sexual activity among HIV sufferers;

(ii) Mistaken beliefs among experts that the epidemic is transmitted predominantly through sexual modes, hence the data that nonsexual modes really dominate are correct, and;

(iii) Errors in test results so the incidence of HIV is significantly lower than reported, especially among those without sexual activity.

The first set of possibilities supports the conventional wisdom that HIV is predominantly sexually transmitted, while the second and third challenge that view. Intentional misreporting and underreporting of sex-related behavior is a well documented phenomenon (O'Sullivan, 2008; Saltzman et al., 2008). Unmarried people may prefer to report as never having had sex (Palen et al., 2008; Begui et al., 2009), married people may not report their extra-marital affairs (de Walque, 2007) and homosexuals may not reveal their behavior due to social desirability bias. It is also possible that some adolescents would unintentionally misreport their sexual behavior if the respondent does not consider

certain sexual acts as 'having sex' (Creek et al., 2006). From a policy perspective, both intentional and unintentional misreporting leads to the same issue; overestimation of the importance of non-sexual modes of HIV transmission. The predominance of non-sexual modes is also supported by several studies. Gisselquist et al. (2002) attribute an important portion of HIV infections in sub Saharan Africa to unsafe medical procedures. The view is also supported by Brewer et al. (2007) and favored by Deuchert (2011).

This paper focuses on the idea that the number of HIV cases not explained by self-reported risky sexual behaviors may include both misreported cases (intentional or unintentional) and genuinely non-sexually transmitted cases. Our goal is to identify what fraction of those cases is misreported. Given the severity of the epidemic and the scarcity of resources available for prevention programs, it is vital that the resource portfolio be optimally balanced between the programs targeting the sexual and non-sexual modes of transmission. This in turn requires better understanding of the transmission of the disease. If misreporting is high and the sexual mode is the dominant mode of transmission, anti-HIV campaigns should focus more on risky sexual behavior and allocate resources to improve sexual education, condom use, and other messages that might reduce the spread of HIV through sex. On the other hand, if misreporting is low and non-sexual modes causes more HIV cases in sub Saharan Africa, prevention interventions should focus more on health care settings, blood safety, injection safety and other such methods of prevention.

Surprisingly, the only serious effort to quantify the extent of misreporting is Deuchert (2011). Although she clearly outlines and explains the problem, her analysis is limited to estimating the proportion of sexually transmitted HIV infections assuming no

misreporting, concluding that 55% of the cases have to be misreported if sex is the dominant mode of transmission of HIV in the selected countries .

3. Pre-marital Sex and the Culture

In many African and Asian societies sexual purity at marriage is highly prized and pre-marital sex is discouraged. As Mensch et al. (2005) write, a young woman engaged in pre-marital sex in sub Saharan Africa 'may bring "dishonor" to the family name." According to George (2008), in South Africa traditional virginity testers not only inspect whether the hymen of a to-be-married female is intact, but also check other features such as the firmness of breasts that are taken to be indicative of her purity and innocence. Molla et al. (2008) provide statistics about the norms and attitudes of 3,743 Ethiopian youth aged 15-24 using a probabilistic sample covering urban and rural areas. As they report, 99% of females believe in girls' virginity and 98% of males believe in boys' virginity and 96% of males and 94% of females intend to marry a virgin. Only 1% of the girls in the sample report pre-marital sex, a figure consistent with their beliefs on virginity. In case of males the respective figure is over 5%.

Bozon (2003) points out that in the countries where the cultural norms are strict and the gender education gap is low males also are expected to be virgins. This is reflected in data from Sri Lanka and Singapore where 'strict supervision of the conduct of young people, including males', is the accepted norm. Accordingly, as the gender differences in socio-economic conditions of women in sub Saharan Africa diminish, men too are expected to comply with accepted social norms.

Wong et al. (2009) investigate the potential factors that are likely to be associated with pre-marital sexual intercourse using a sample of 500 unmarried adolescents from Singapore who have engaged with premarital sexual activities, using a matched control sample. Among the factors that they find significant are less education, low income, permissive attitudes, peer pressure, substance use, previous sexual abuse and exposure to sexual content in media. Fernandez-Villaverde et al. (2010) document much higher rates of pre-marital sexual acts among low-income families than wealthier families. Kabiru and Orpinas (2009) based on a sample of high school children from Nairobi, Kenya, find that religiosity, perceived parental attitudes towards sex, living arrangements, and school characteristics are among the factors associated with pre-marital sex. Billdelcom et al. (2008) using data from the 2004 National Survey of Adolescents conducted in Burkina Faso, Ghana, Malawi, and Uganda show a negative association between pre-marital sex and the number of years at school.

Pre-marital sex is discouraged in the teachings of most mainstream religions (Rowatt and Shmitt, 2010). Barkan (2006) shows the association between the religiosity and pre-marital sex using the data from General Social Survey of the US, which he partly claims to be a result of moral disapproval of pre-marital sex by Judeo-Christian religions. But, as Leonard and Scott-Jones (2010) show people always do not behave in accordance with their beliefs. In their study using a sample of 118 high school seniors they find that even though nearly a half of the sample acknowledges religious teachings on sexual activity and a third believes that the religion is against pre-marital sex, the self-reported sexual behavior is inconsistent with religious beliefs.

As shown in Fernandez-Villaverde et al. (2010) the social acceptance of premarital sex has always lagged the practice. It is clear that when the social norms are more supportive, adolescents engage more in pre-marital sex. At the same time, the more the younger generation experience pre-marital sex the more it becomes an accepted norm. The attitude towards premarital sex is changing even in most traditional societies. According to Mensch et al. (2005), in 19 of the 27 sub Saharan African countries that they study, women who had pre-marital sex by age 18 has increased significantly during a period of two decades. Among the women aged 20-24 most common context of sexual debut is pre-marital sex in 13 of the 27 countries. However, it has been so in only 6 countries among the cohort born 20 years earlier.

People who engage in pre-marital sexual acts may not reveal their behavior if they have reasons to believe that sharing their true self would place them in a disadvantageous position. This can be the situation when the societal stance on pre-marital sex is not permissive. This phenomenon is termed as 'social desirably bias' in psychology, medicine and other social sciences. Social desirability bias causes self-reported answers to a survey questionnaire to be biased 'in a way that makes the person look positive with regard to culturally derived norms and standards' (Ganster et al., 1983). The gap between the social acceptance and practice (Fernandez-Villaverde et al., 2010) and the belief-behavior gap (Leonard and Scott-Jones, 2010), thus, may persuade individuals to falsely report their confidential pre-marital relationships even if a survey is well-structured. Another specific reason to misreport sexual behavior by adolescents is when they are sexually abused by a family member or a close relative. Under those circumstances, the decision to engage in sex may not be intentional, but the decision not to reveal such act would be.

4. The Model

We model the data generating process as the result of two sequential decisions. First the agents decide whether to abstain from pre-marital sex (y_{1i}), based on their unobservable expected utility (y_{1i}^*) .The second decision is conditional on the first. Those who did not abstain from pre-marital sex make a second decision, whether to reveal their true status or misreport (y_{1i}), based on some unobservable expected utility (y_{2i}^*). The agents who did abstain from pre-marital sex, however, make no further decisions and report their true status, i.e., if $y_{1i} = 1, y_{2i} = 0 \; for \; \forall i$.

If we can observe both y_{1i} and y_{2i}, the model is analogous to the classical sample selection model (Heckman, 1979) as follows[4]:

$$
\begin{aligned}
& y_{ji}^* = x_{ji}\beta_j + \varepsilon_{ji}, \qquad j = 1,2 \\
& y_{1i} = \begin{Bmatrix} 0\{y_{1i}^* \le 0\} \\ 1\{y_{1i}^* > 0\} \end{Bmatrix} \\
& y_{2i} = \begin{Bmatrix} 0\{y_{2i}^* \le 0\} \\ 1\{y_{2i}^* > 0\} \end{Bmatrix}, \qquad \text{if } y_{1i} = 0
\end{aligned} \tag{1}
$$

For identification, we assume bivariate normal errors such that, $\begin{bmatrix} \varepsilon_{1i} \\ \varepsilon_{2i} \end{bmatrix} \sim BVN\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 & \rho \\ \rho & 1 \end{bmatrix} \right)$.

The decision sequence leads to three potential outcomes.

Never having sex	$: \Pr[(y_{1i} = 1) \,\&\, (y_{2i} = 0)] = \Phi(x_{1i}\beta_1)$
Having sex and misreporting	$: \Pr[(y_{1i} = 0) \,\&\, (y_{2i} = 1)] = \Phi_2(-x_{1i}\beta_1, x_{2i}\beta_2, -\rho)$
Having sex and revealing	$: \Pr[(y_{1i} = 0) \,\&\, (y_{2i} = 0)] = \Phi_2(-x_{1i}\beta_1, -x_{2i}\beta_2, \rho)$

[4] In classical sample selection model, we observe y_{2i} when $y_{1i} = 0$.

In above $\Phi(.)$ and are $\Phi_2(.)$ are the univariate and bivariate cumulative distribution functions respectively. We assume the remaining combination of being a virgin but reporting pre-marital sex $(y_{1i}=1)\,\&\,(y_{2i}=0)$ has zero probability.

The problem at hand is that we do not observe the first and second outcomes above separately. The observed binary outcome for being a virgin, $y_i=1,$ is given by $y_i = y_{1i} + y_{2i}$ where $\Pr(y_i=1)=1-\Phi_2(-x_{1i}\beta_1,-x_{2i}\beta_2,\rho)$ and $\Pr(y_i=0)=\Phi_2(-x_{1i}\beta_1,-x_{2i}\beta_2,\rho)$, which is a univariate mapping of an underlying bivariate decision process. We emphasize that we are unable to differentiate between true virgins and those who only claim to be virgins, hence the only observations we are sure of are those for $y_i=0.$ The model is equivalent to the bivariate model with partial observability presented in Poirier (1980), except having opposite signs for β s. In fact, if we use $(1-y_i)$ as the dependant variable instead of y_i the two models are identical and the parameters of the model are identified when the vectors $x_{1i}\neq x_{2i}$, except under the 'peculiar' conditions specified in Poirier (1980)[5]. If we have reasons to believe that the error terms are uncorrelated, we can assume $\rho=0$ as in Abowd and Farber (1982)[6]. Under this assumption we can express the expected value of the observed dependant variable as,

(2) $E\left(y_i \mid x_{1i},x_{2i}\right)=\Pr\left(y_i=1\mid x_{1i},x_{2i}\right)=1-\Phi\left(-x_{1i}\beta_1\right).\Phi\left(-x_{2i}\beta_2\right).$

The model is a restricted version of Tennekoon and Rosenman (2010) where $\Pr(y_{2i}=1\mid y_{1i}=1)=0$. It is identical to Abowd and Farber (1982) when the signs of β s are

[5] The 'peculiar' conditions stated in Poirier (1980) are related to insufficient variability of exogenous variables.

[6] In the application follows, we found no statistical evidence of correlated errors.

reversed. The parameters of the model can be estimated by maximizing the following log-likelihood function.

$$(3)\quad ll(\beta_1,\beta_2;x_{1i},x_{2i}) = n^{-1}\sum_{i=1}^{n}\left(\begin{array}{r} y_i \ln\left[1-\Phi(-x_{1i}\beta_1).\Phi(-x_{2i}\beta_2)\right] \\ +(1-y_i)\ln\left[\Phi(-x_{1i}\beta_1).\Phi(-x_{2i}\beta_2)\right] \end{array}\right)$$

The percentage of misreported cases in the sample can be estimated as,

$$(4)\quad E\Pr\left[(y_{2i}=1)\,\&\,(y_{1i}=0)\right] = \frac{1}{n}\sum_{i=1}^{N}\Phi(-x_{1i}\hat{\beta}_1).\Phi(x_{2i}\hat{\beta}_2)$$

$$\text{where}\quad \begin{bmatrix}\hat{\beta}_1\\ \hat{\beta}_2\end{bmatrix} = \arg\max\left(ll(\beta_1,\beta_2;x_{1i},x_{2i})\right)$$

The percentage of true virgins in the population is estimated as,

$$(5)\quad E\Pr\left[(y_{1i}=1)\right] = \Pr\left[(y_i=1)\right] - E\Pr\left[(y_{2i}=1)\,\&\,(y_{1i}=0)\right] = \frac{1}{n}\sum_{i=1}^{N} y_i - \frac{1}{n}\sum_{i=1}^{N}\Phi(-x_{1i}\hat{\beta}_1).\Phi(x_{2i}\hat{\beta}_2).$$

Finally, the percentage of true virgins in the HIV-infected sub population is estimated as,

$$(6)\quad E\Pr\left[(y_{1i}=1)\,|\,(H_i=1)\right] = \frac{1}{n}\sum_{i=1}^{N} y_i.H_i - \frac{1}{n}\sum_{i=1}^{N}\Phi(-x_{1i}\hat{\beta}_1).\Phi(x_{2i}\hat{\beta}_2).H_i$$

where H_i is an indicator variable equal to 1 if found HIV positive and 0 otherwise.

Statistical inferences of estimates are calculated using the delta method.

5. The Application

The top 6 countries in the world in terms of adult HIV prevalence rate are Swaziland (25.9%), Botswana (24.8%), Lesotho (23.6%), South Africa (17.8%), Zimbabwe (14.3%) and Zambia (13.5%), all located in Southern Africa (UNAIDS, 2010). For our analysis of various factors affecting the decision to engage in pre-marital sex and not to report such behavior truthfully, we chose 4 of these countries (Swaziland, Lesotho, Zimbabwe and

Zambia) for which comparable data of required variables are available in Demographic and Health Surveys (DHS). The four countries selected have many similarities in terms of their socio-economic conditions including the income level, average life expectancy, adult literacy rate, years of schooling, income level and the degree of urbanization. Previous literature has identified that a significant fraction of unmarried adolescents who are HIV positive in these countries have self-reported as never having sex. Accordingly, the focus group of our study was the never married adolescents in 15-19 age range from both genders.

The Data

Our analysis is based on the most recent standard Demographic and Health Surveys administered in the selected countries and supplemented with volunteer HIV testing. The Demographic and Health Surveys, implemented in each country by local statistical agencies with the technical assistance of the MEASURE DHS project funded by USAID, are based on nationally representative random household samples from over 85 countries. The HIV test results of the survey respondents who voluntarily provide blood samples, however, are available only for around 30 countries. The focus group of these surveys is women in their reproductive age (15-49 years), but men living in the same households also are interviewed[7].

Our interest here is on the never married group of men and women aged 15-19 years of these countries. The selected sub-sample comprises 5,570 women and 5,341 men.

[7] In certain countries including Lesotho only the men living in a random subset of the original sample of households have been interviewed.

Sixty seven percent of unmarried adolescent men and 72% of unmarried adolescent women self-report that they have never had sex. HIV is present in 361 members (111 men and 250 women) of the sample, with prevalence in the sample ranging from 1.5% for men in Lesotho to 7.7% for women in Swaziland. Yet 76 men and 116 women who claim to never have had sex tested HIV positive, corresponding to 68% of HIV infected men and 46% of HIV infected women among unmarried adolescents. Given the standard of the documented HIV testing procedure, we assume that the laboratory procedures to ensure a person's HIV status are reliable. Accordingly, we ignore the possibility of 'fake positive results' as suggested by Brewer et al. (2007).

In order to estimate the parameters in equation (3) we selected variables as the determinants of each decision, never having sex and misreporting, in light of the previous literature discussed in section 3. As the covariates of never having sex, we use age (categorized by age group), education level, wealth category (richer and richest categories referenced to lower wealth categories), place of residence (country dummies and whether urban or rural), employment status and smoking status. All these variables have been found associated with pre-marital sex in previous studies.

The decision to misreport the pre-marital activities by an adolescent depends on social pressure against such behavior. We used country dummies and an indicator for residents in urban areas to capture the difference in social pressure across countries and between rural and urban areas. As the sexual relationships at a very young age are generally discouraged by most societies the tendency to misreport is likely to decrease with age. We included age dummies to capture this association. If a third person is present

when the survey is administered adolescents, particularly the female, are less likely to report sexual acts. The dataset for female contains whether a third person older than 10 years was present and the gender of that person. We exploit the availability of this information and included two variables, the presence of a male adult and the present of a female adult, as covariates of misreporting. This information, however, is not available for male. We also included HIV status as a covariate of misreporting in order to assess whether the adolescents infected with HIV are systematically different from others in terms of misreporting. The variables that we used for estimating the model and the relevant summary statistics are reported in Table-1[8].

Analysis of Estimation Results

The parameter estimates from MLE are presented in Tables 2-4. In Table 2, we report the parameter estimates of equation (3) for female adolescents. We observe the expected sign with most of the coefficients of the covariates of both never having sex and misreporting. In Table 3, we report the estimates for adolescent males using a model with all the covariates that we used with females. The results show great consistency between the factors contributing to the sexual behavior of male and female adolescents. However, unlike for the estimates for female, the tendency to misreport by male does not appear to depend on any covariates we used, except the constant term. On those grounds, we estimated a restricted model with the male sample having only a constant term as a covariate of misreporting. A likelihood ratio test between the restricted and unrestricted

[8] Religion and ethnicity which could have an impact on each decision were not used to avoid a potential identification issue since they were without sufficient variability. Preliminary estimations showed that the education level is not a significant factor influencing misreporting, which suggests that unintentional misreporting is not substantial.

models favors the restricted model that we present in Table 4. Therefore, we use the results from the restricted model for our discussions about males. The same results are used to estimate the extent of misreporting by male that we present later. In any case, the estimates of the two models for males are highly consistent.

As the results show, the possibility that a person has never had sex decreases with age as expected, showing the effect of increasing exposure as an adolescent spends more time as a sexually active person, a result consistent for both genders. For female this transition is faster than for male. The more educated a person is the more the chance that the person remains a virgin. The result again is consistent across genders and stronger with female than male. There are at three reasons to explain the effect of education on premarital sex. First, the more one devotes her[9] time for education the less her time available to spend with a partner. Second, with improved knowledge she is more aware of the risks associated. The two reasons are common to both genders. Finally, the opportunity cost of pre-marital sex is higher for a woman who has ambitious education goals than for a man with similar goals since an unexpected pregnancy would almost always shatter an adolescent woman's dreams in this part of the world. This may explain the larger effect on female compared to male.

The wealth effect on being a virgin is positive for both genders, in particularly between the wealthiest 20% of the population and the others. This may indicate the higher opportunity cost of pleasure from sex for wealthier people due to availability of various other entertainment options and also because wealthier individuals may value their health

[9] We use ~~femininity~~ feminine pronouns for convenience when referring to both genders.

more, or being sick has a higher opportunity cost, than it does for poorer people, and thus the wealthy are less likely to participate in risky behavior. People living in urban areas and those who are employed are more likely to have pre-marital sex than their counterparts living in rural areas and are unemployed. The result, consistent across genders, is intuitive. The employed and the residents of urban areas face more chances to interact with people and thus more likely to find a matching partner than an unemployed person or a person from a rural area. Being an urban resident, however, was not an important factor for males as for females. Finally, smokers were less likely to be virgins than non-smokers. This may show the risky lifestyle of smokers and other substance users.

As we stated early, the tendency to misreport by adolescent females vary across countries and between urban and rural areas, indicating that the social pressure exerted upon them differs across cultures. This is not so for males for whom misreporting is more random than systematic. The younger a female adolescent the more her likelihood of misreporting, showing that the social pressure to remain a virgin diminishes with age or perhaps she becomes less susceptible to social pressure as she ages. The impact of the presence of another female when the survey questionnaire was answered is neutral. However, when another male was present, female adolescents were significantly more likely to misreport than when they were alone. This indicates that the social pressure excreted on female adolescents in southern Africa to remain a virgin until their marriage is sourced mainly from the opposite gender. Finally, the HIV positive females were less likely to misreport, probably because they have less to gain from doing so than a healthy woman. We did not notice such an effect with men.

Population Level Estimates of Misreporting

Having fitted the values of the model parameters, it is straight forward to estimate the expected misclassification probabilities at the individual level. We can use these individual estimates to derive population level estimates using equations (5) and (6). As presented in Table 5, the estimated percentage of female adolescents who really are virgins is only 31.1%, compared with 72.1% who report so. Among male adolescents, however, misreporting is not so substantial. Out of the 67% of males who report never having sex, we estimate 62% do so honestly[10] .The estimates for the HIV-infected sub population also are closer to the population level estimates of male adolescents. We estimate that there are 62.0% true virgins among HIV infected male adolescents compared to 68.5% reported virgins. HIV infected female adolescents, however, are less likely to misreport than healthy females. Among the 46.4% of reported virgins tested HIV positive, we estimate that 24.4% are true virgins.

The estimated level of misreporting is definitely not ignorable, particularly in case of females which is closer to the Deuchert (2011) threshold of 55%. The important question in front of us is, are these numbers alarming? However, it is not possible to make any strong conclusion by just looking at the percentage of HIV infected people who have never exposed themselves to sexual acts, as some of the past researchers do. To clarify the point, if we check a sample of HIV affected children below 5 years, we will find nearly 100% of them are virgins. What we really need to check is what percentage of individuals with no

[10] The striking difference in the rate of estimated virginity between males and females may be a factor of dating patterns among youths. Adolescent girls are more likely to date older men (see Bozon, 2003), and those men may have expectations about sexual activity.

exposure to sexual mode of HIV transmission is infected. We present these estimates using both the reported results, as well as the estimated results, in Table 6.

The findings, in fact, are alarming. On average, 3.52% of adolescent females and 2.14% of adolescent males get infected by HIV without sexual exposure. In comparison, the observed HIV prevalence rates among the entire sample of females and males of these countries are 4.49% and 2.10% respectively. Considering that the people who have sexual relationships too are equally exposed to non-sexual modes of HIV-transmission as others (i.e. ignoring the possibility of any selection effect), we observe no marginal increase in risk of HIV by having premarital sex for adolescent men in these countries. For the adolescent females too the increase in risk is only 0.97%. The results vary across the four countries as shown in the table, but not to be qualitatively different from the overall results. The correction for misreporting does not alter these statistics much. Thus, we can easily isolate the problem from the issue of misreporting. This favors the argument that the HIV epidemic in sub Saharan Africa is related to the general medical procedures in these countries and any other potential sources than risky sexual behavior.

The results, in particular, are consistent with the findings of Deuchert (2011), which states that 70% of the HIV infections among the female adolescents in Lesotho, Swaziland and Zimbabwe are not due to sexual transmission, assuming no misreporting. In our sample that also includes Zambia, we find the respective number is 78% after correcting for misreporting. A higher percentage of misreporting, however, does not necessarily invalidate this estimate as she claims, since not only the HIV-infected choose to misreport. In fact, as our estimates show, the healthy female adolescents are more likely to misreport

than the HIV-infected[11]. Accordingly, our correction for misreporting only strengthens the finding of Deuchert (2011) that the sexual mode has a lesser role than widely believed. We do not find any research for adolescent males in these countries to compare our estimates with. Our results using the male sample more strongly support the dominance of non-sexual modes than does the analysis using the female sample.

6. Conclusions

It has been widely speculated that the high rate of HIV prevalence among adolescents in Southern and Eastern Africa who self-report themselves as virgins is a result of misreporting. Our findings show that, even though misreporting is sizable, it doesn't explain the anomaly. This finding isolates the 'virgin-HIV puzzle' from the issue of misreporting, but still leaves the main issue unanswered. Many people view the HIV epidemic in sub Saharan Africa the same way as it spreads and prevails in the regions with better socio-economic conditions. A sizable amount of research, however, acknowledges that the epidemic in sub Saharan Africa has to be viewed differently. It has been suggested that unsafe medical procedures including untested blood transfusion and injections with unsterile needles and syringes as well as the higher susceptibility to the virus after the immune system being weakened by other deceases like malaria, tuberculosis, cholera or parasitic diseases and malnutrition in general are responsible for the high rates of HIV prevalence in Africa than the heterosexual transmission(Geshekter, 1994; Gisselquist et al., 2002; Schneider and Drucker 2006; Brewer et al., 2007).

[11] Healthy female adolescents have more to lose from revealed sexual activity than those with HIV, since the presence of HIV already "taints" her in the marriage market. Thus, our finding that healthy female adolescents misreport much more frequently is not surprising.

The strategies to prevent the epidemic in Africa still rely mainly on limiting heterosexual relationships, promoting abstention, promoting contraceptive use and improving gender equality to strengthen women's position in negotiating sexual relationships. This practice of attempting to 'turn African women into "gatekeepers" who negotiate sexual relations and risk-reduction strategies' has been criticized since Geshekter (1994). Despite a growing literature on causes of HIV transmission in Africa other than heterosexual activity, the unreliability of the self-reported survey responses has largely been exploited by several scholars in their attempts to maintain the accepted hypothesis that HIV is predominantly sexually transmitted in the sub Saharan African countries too. In the absence of any quantitative estimates for the extent of misreporting, the proponents of non-sexual modes of transmission lacked weapons to defend their position. The findings of this paper turn the balance towards their favor.

References

Abowd JM, Farber HS. Job Queues and the Union Status of Workers. Industrial and Labor Relations Review 1982; 35(3); 354-269.

Barkan, SE. Religiosity and Premarital Sex in Adulthood. Journal for the Scientific Study of Religion 2006; 45; 407-417. doi: 10.1111/j.1468-5906.2006.00315.x

Beguy D, Kabiru CW, Nderu EN, Ngware MW. Inconsistencies in Self-Reporting of Sexual Activity Among Young People in Nairobi, Kenya. Journal of Adolescent Health 2009; 45(6): 595-601.

Biddlecom A, Gregory R, Lloyd CB, Mensch BS. Associations Between Premarital Sex and Leaving School in Four Sub-Saharan African Countries. Studies in Family Planning 2008; 39; 337-350. doi: 10.1111/j.1728-4465.2008.00179.x

Brewer DD, Potterat JJ, Muth SQ. Brody S. Converging evidence suggests nonsexual HIV transmission among adolescents in sub-Saharan Africa. Journal of Adolescent Health 2007; 40(3); 290-291.

Boulos D, Yan P, Schanzer D, Remis RS, Archibald CP. Estimates of HIV prevalence and incidence in Canada, 2005. Canada Communicable Disease Report 2006; 32(15).

Bozon M. At what age do women and men have their first sexual intercourse? World comparisons and recent trends. Population et Sociétés 2003; 391; 1-4.

Centers for Disease Control and Prevention. HIV Surveillance Report 2008; 20. http://www.cdc.gov/hiv/topics/surveillance/resources/reports/. Published June 2010. Accessed 10.22.2010.

Creek TL, Alwano MG, Molosiwa RR, Roels TH, Kenyon TA, Mwasalla V, Lloyd ES, Mokomane M, Hastings PA, Taylor AW, Kilmarx PH. Botswana's Tebelopele Voluntary HIV Counseling and Testing Network Use and Client Risk Factors for HIV Infection, 2000–2004. Journal of Acquired Immune Deficiency Syndromes 2006; 43(2); 210-218.

de Walque D. Sero-discordant Couples in Five African Countries: Implications for Prevention Strategies. Population and Development Review 2007; 33(3); 501-523.

Deuchert E. The Virgin HIV Puzzle: Can Misreporting Account for the High Proportion of HIV Cases in Self-Reported Virgins? Journal of African Economics 2011; 20(1); 60-89.

Fernández-Villaverde J, Greenwood J, Nezih G. From Shame to Game in One Hundred Years: An Economic Model of the Rise in Premarital Sex and its De-Stigmatization. Economie d'avant garde, Research Report No. 16; 2010. Available at SSRN: http://ssrn.com/abstract=1313185.

Ganster DC, Hennessey HW, Luthans F.Social Desirability Response Effects: Three Alternative Models. The Academy of Management Journal 1983; 26(2); 321-331.

Gavin L, Galavotti C, Dube H, McNaghten AD, Murwirwa M, Khan R, St Louis M. Factors Associated with HIV Infection in Adolescent Females in Zimbabwe Journal of Adolescent Health 2006; 39(4); 596.e11-596.e18.

Geshekter CL (Reprint). AIDS in Africa: Myths of AIDS and Sex. Jenda: A Journal of Culture and African Women Studies 2001; 1(2). http://www.jendajournal.com/jenda/vol1.2/toc1.2.htm

George ER. Virginity Testing and South Africa's HIV/AIDS Crisis: Beyond Rights Universalism and Cultural Relativism Toward Health Capabilities. California Law Review 2008; 96; 1447-1519.

Ghys PD, Brown T, Grassly NC, Garnett G, Stanecki KA, Stover J, Walker N. The UNAIDS Estimation and Projection Package: a software package to estimate and project national HIV epidemics. Sexually Transmitted Infections 2004; 80; i5–i9. doi: 10.1136/sti.2004.010199.

Gisselquist D, Rothenberg R, Potterat J, Drucker E. HIV infections in sub-Saharan Africa not explained by sexual or vertical transmission. International Journal of STD & AIDS 2002; 13; 657-666.

Gouws E, White PJ, Stover J, Brown T. Short term estimates of adult HIV incidence by mode of transmission: Kenya and Thailand as examples. Sexually Transmitted Infections 2006; 82; iii51–iii55. doi: 10.1136/sti.2006.020164.

Hall HI, Song R, Rhodes P, Prejean J, An Q, Lee LM, Karon J, Brookmeyer R, Kaplan EH, McKenna MT, Janssen RS. Estimation of HIV Incidence in the United States. The Journal of American Medical Association 2008; 300(5); 520-529.

Herida M, Alix J, Devaux I, Likatavicius G, Desenclos JC, Matic S, Ammon A, Nardone A. HIV/AIDS in Europe: epidemiological situation in 2006 and a new framework for surveillance. Euro Surveillance

2007;12(47):pii=3312. Available online:
http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=3312

Kabiru CW, Orpinas P. Factors associated with sexual activity among high-school students in Nairobi, Kenya. Journal of Adolescence 2009; 32(4); 1023-1039.

Kenya National Bureau of Statistics (KNBS) and ICF Macro. 2010. Kenya Demographic and Health Survey 2008-09. Calverton, Maryland: KNBS and ICF Macro.

Leonard KC, Scott-Jones D. A Belief-Behavior Gap? Exploring Religiosity and Sexual Activity Among High School Seniors. Journal of Adolescent Research 2010; 25(4); 578–600.

Lyerta R, Gouws E, Garcia-Calleja JM, Zaniewsky E. The 2005 workbook: An improved tool for estimating HIV prevalence in countries with low level and concentrated epidemics. Sexually Transmitted Infections 2006; 82; 41-44.

Mensch BS, Grant MJ, Blanc AK. The Changing Context of Sexual Initiation in Sub-Saharan Africa. Population and Development Review 2006; 32(4); 699-727.

Molla M, Berhane Y, Lindtjørn B. Traditional values of virginity and sexual behaviour in rural Ethiopian youth: results from a cross-sectional study. BMC Public Health 2008; 8(9). doi:10.1186/1471-2458-8-9.

O'Sullivan LF. Challenging Assumptions Regarding the Validity of Self-Report Measures: The Special Case of Sexual Behavior. Journal of Adolescent Health 2008; 42(3); 207-208.

Palen L, Smith EA, Caldwell LL, Flisher AJ, Wegner L, Vergnani T. Inconsistent Reports of Sexual Intercourse Among South African High School Students. Journal of Adolescent Health 2008; 42(3); 221-227.

Public Health Agency of Canada. HIV and AIDS in Canada. Surveillance Report to December 31, 2008. Surveillance and Risk Assessment Division, Centre for Communicable Diseases and Infection Control, Public Health Agency of Canada, 2009.

Poirier DJ. Partial observability in bivariate probit models. Journal of Econometrics 1980; 12(2); 209-217

Rowatt WC, Schmitt DP. Associations Between Religious Orientation and Varieties of Sexual Experience. Journal for the Scientific Study of Religion 2003; 42(3); 455-465.

Saltzman SP, Stoddard AM, McCusker J, Moon MW, Mayer KH. Reliability of Self-Reported Sexual Behavior Risk Factors for HIV Infection in Homosexual Men. Public Health Reports 1987; 102(6); 692-607.

Schmid GP, Buvé A, Mugyenyi P, Garnett GP, Hayes RJ, Williams BG, Calleja JG, De Cock KM, Whitworth JA, Kapiga SH, Ghys PD, Hankins C, Zaba B, Heimer R, Boerma JT. Transmission of HIV-1 infection in sub-Saharan Africa and effect of elimination of unsafe injections. Lancet 2004; 363; 482-488.

Schneider WH, Drucker E. Blood Transfusions in the Early Years of AIDS in Sub-Saharan Africa. American Journal of Public Health 2006; 96(6); 984–994. doi: 10.2105/AJPH.2004.061630.

Tennekoon V, Rosenman R. Treatment Evaluation with a Systematically Misclassified Outcome Variable. Unpublished. 2010.

Uganda National AIDS Commission. Uganda HIV Modes of Transmission and Prevention Response Analysis. Final Report March 2009.

Joint United Nations Programme on HIV/AIDS (UNAIDS). Global report: UNAIDS report on the global AIDS epidemic 2010.

United Nations Development Programme. Human development report. New York, NY, UNDP. 2005.

World Health Organization. Towards universal access: scaling up priority HIV/AIDS interventions in the health sector: progress report 2010.

Wong M, Chan RK, Koh D, Tan H, Lim F, Emmanuel S, Bishop G. Premarital Sexual Intercourse Among Adolescents in an Asian Country: Multilevel Ecological Factors. Pediatrics 2009; 124; e44-e52. DOI: 10.1542/peds.2008-2954.

Table 1: Summary Statistics

	Lesotho	Swaziland	Zambia	Zimbabwe	All
Females aged 15-19 and never married					
Number of observations	1,438	1,166	1,302	1,664	5,570
Means of variables					
Reported never having sex	0.698	0.630	0.616	0.886	0.721
HIV Positive	0.030	0.077	0.044	0.036	0.045
Age					
15 years	0.212	0.207	0.276	0.213	0.226
16 years	0.259	0.223	0.232	0.261	0.246
17 years	0.197	0.220	0.190	0.189	0.198
18 years	0.183	0.178	0.160	0.186	0.177
19 years	0.150	0.172	0.142	0.151	0.153
Education					
Secondary	0.414	0.600	0.531	0.770	0.587
Higher	0.000	0.005	0.005	0.004	0.003
Wealth					
Richest (First quintile)	0.136	0.159	0.113	0.148	0.139
Richer (Second quintile)	0.193	0.178	0.137	0.153	0.165
Other					
Employed	0.177	0.120	0.195	0.210	0.179
Urban	0.266	0.234	0.543	0.408	0.367
Smoker	0.006	0.005	0.004	0.003	0.004
Survey environment					
Adult male was present	0.062	0.033	0.068	0.047	0.053
Adult female was present	0.108	0.058	0.127	0.081	0.094
Males aged 15-19 and never married					
Number of observations	742	1,248	1,391	1,960	5,341
Means of variables					
Reported never having sex	0.535	0.789	0.529	0.735	0.666
HIV Positive	0.015	0.016	0.025	0.023	0.021
Age					
15 years	0.179	0.223	0.213	0.190	0.202
16 years	0.249	0.237	0.202	0.207	0.218
17 years	0.213	0.197	0.208	0.221	0.211
18 years	0.187	0.188	0.197	0.209	0.198
19 years	0.171	0.155	0.180	0.173	0.171
Education					
Secondary	0.264	0.479	0.504	0.681	0.530
Higher	0.003	0.002	0.005	0.004	0.003
Wealth					
Richest (First quintile)	0.146	0.177	0.151	0.184	0.169
Richer (Second quintile)	0.191	0.204	0.119	0.206	0.181
Other					
Employed	0.214	0.198	0.409	0.327	0.302
Urban	0.228	0.182	0.477	0.264	0.295
Smoker	0.133	0.024	0.033	0.049	0.051

Table 2: Results of Female Sample

Variable	Estimate		Std. dev.	p-value
Never Engaging with Pre-marital Sex				
Constant	-1.469	***	0.282	0.000
Country dummies				
Lesotho: Excluded				
Swaziland	0.448	**	0.209	0.032
Zambia	-0.428	*	0.255	0.093
Zimbabwe	-0.424		0.398	0.286
Age				
15 years	1.794	***	0.212	0.000
16 years	1.018	***	0.211	0.000
17 years	0.521	***	0.197	0.008
18 years	0.318		0.204	0.119
19 years: Excluded				
Education				
Secondary	0.483	***	0.117	0.000
Higher	2.071	***	0.611	0.001
Wealth				
Richest (First quintile)	0.630	***	0.145	0.000
Richer (Second quintile)	0.184		0.114	0.108
Other				
Employed	-1.195	***	0.466	0.010
Urban	-0.537	***	0.181	0.003
Smoker	-0.933		0.836	0.265
Misreporting				
Constant	-0.334	***	0.109	0.002
HIV positive	-0.711	***	0.139	0.000
Country dummies				
Lesotho: Excluded				
Swaziland	-0.684	***	0.211	0.001
Zambia	-0.214	*	0.110	0.053
Zimbabwe	0.918	***	0.115	0.000
Age				
15 years	0.774	***	0.177	0.000
16 years	0.780	***	0.112	0.000
17 years	0.464	***	0.098	0.000
18 years	0.226	**	0.097	0.020
19 years: Excluded				
Other				
Urban	0.189	***	0.073	0.010
Survey environment				
Adult male was present	0.267	**	0.133	0.045
Adult female was present	-0.035		0.102	0.731
Number of observations				5,570
Log-likelihood				-2736.61
Adjusted pseudo R-squared				0.162

** p<0.1,**p<0.05,***p<0.001*

Table 3: Results of Male Sample - Unrestricted Model

Variable	Estimate		Std. Dev.	p-value
Never Engaging with Pre-marital Sex				
Constant	-0.916	***	0.138	0.000
Country dummies				
Lesotho: Excluded				
Swaziland	0.933	***	0.121	0.000
Zambia	0.056		0.112	0.618
Zimbabwe	0.758	***	0.111	0.000
Age				
15 years	1.625	***	0.124	0.000
16 years	1.159	***	0.145	0.000
17 years	0.837	***	0.122	0.000
18 years	0.392	***	0.126	0.002
19 years: Excluded				
Education				
Secondary	0.102	**	0.053	0.051
Higher	0.323		0.397	0.415
Wealth				
Richest (First quintile)	0.146	*	0.081	0.071
Richer (Second quintile)	0.003		0.065	0.968
Other				
Employed	-0.361	***	0.053	0.000
Urban	0.018		0.087	0.830
Smoker	-1.681	***	0.326	0.000
Misreporting				
Constant	-0.891	***	0.179	0.000
HIV positive	0.002		0.407	0.996
Country dummies				
Lesotho: Excluded				
Swaziland	-0.437		0.472	0.356
Zambia	-0.258		0.220	0.241
Zimbabwe	-0.092		0.253	0.715
Age				
15 years	-3.218		23.385	0.891
16 years	0.052		0.436	0.906
17 years	0.048		0.304	0.875
18 years	0.132		0.231	0.568
19 years: Excluded				
Other				
Urban	-0.091		0.189	0.631
Number of observations				5,341
Log-likelihood				-2806.08
Adjusted pseudo R-squared				0.168

** p<0.1,**p<0.05,***p<0.001*

Table 4: Results of Male Sample - Restricted Model

Variable	Estimate		Std. Dev.	p-value
Never Engaging with Pre-marital Sex				
Constant	-0.908	***	0.135	0.000
Country dummies				
Lesotho: Excluded				
Swaziland	0.832	***	0.086	0.000
Zambia	-0.041		0.079	0.600
Zimbabwe	0.726	***	0.082	0.000
Age				
15 years	1.564	***	0.103	0.000
16 years	1.207	***	0.094	0.000
17 years	0.882	***	0.088	0.000
18 years	0.456	***	0.082	0.000
19 years: Excluded				
Education				
Secondary	0.109	**	0.054	0.041
Higher	0.296		0.425	0.486
Wealth				
Richest (First quintile)	0.145	*	0.083	0.079
Richer (Second quintile)	0.004		0.066	0.956
Other				
Employed	-0.372	***	0.054	0.000
Urban	-0.005		0.072	0.945
Smoker	-1.717	***	0.312	0.000
Misreporting				
Constant	-0.989	***	0.130	0.000
Number of observations				5341
Log-likelihood				-2808.64
Adjusted pseudo R-squared				0.1697

** p<0.1,**p<0.05,***p<0.001*

Table 5: Reported and Estimated Proportions of Virgins

		Among all adolescents			Among the HIV-infected		
Gender	**Country**	**Reported**	**Estimated**	**Std. Dev.**	**Reported**	**Estimated**	**Std. Dev.**
Female	Lesotho	0.698	0.324	0.084	0.512	0.290	0.077
	Swaziland	0.630	0.494	0.065	0.333	0.277	0.040
	Zambia	0.616	0.225	0.085	0.404	0.214	0.067
	Zimbabwe	0.886	0.238	0.124	0.683	0.188	0.118
	All-female	***0.721***	***0.311***	***0.095***	***0.464***	***0.244***	***0.077***
Male	Lesotho	0.535	0.445	0.023	0.455	0.350	0.254
	Swaziland	0.789	0.749	0.013	0.850	0.805	0.013
	Zambia	0.529	0.439	0.023	0.571	0.489	0.021
	Zimbabwe	0.735	0.684	0.015	0.756	0.705	0.016
	All-male	***0.666***	***0.602***	***0.018***	***0.685***	***0.620***	***0.018***

Table 6: HIV Prevalence Rates

Gender	**Country**	**Reported Virgins**	**Estimated Virgins**	**Population**
Female	Lesotho	2.19%	2.68%	2.99%
	Swaziland	4.08%	4.33%	7.72%
	Zambia	2.87%	4.16%	4.38%
	Zimbabwe	2.78%	2.85%	3.61%
	All-female	**2.89%**	**3.52%**	**4.49%**
Male	Lesotho	1.26%	1.17%	1.48%
	Swaziland	1.73%	1.72%	1.60%
	Zambia	2.72%	2.80%	2.52%
	Zimbabwe	2.36%	2.36%	2.30%
	All-male	**2.14%**	**2.14%**	**2.08%**