

Is unsafe sexual behaviour increasing among HIV-infected individuals?

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Study*

Background: The number of new diagnoses of HIV infection is rising in the north-western hemisphere and it is becoming increasingly important to understand the mechanisms behind this trend.

Objective: To evaluate whether reported unsafe sexual behaviour among HIV-infected individuals is changing over time.

Design: Participants in the Swiss HIV Cohort Study were asked about their sexual practices every 6 months for 3 years during regular follow-up of the cohort beginning on 1 April 2000.

Methods: Logistic regression models were fit using generalized estimating equations assuming a constant correlation between responses from the same individual.

Results: At least one sexual behaviour questionnaire was obtained for 6545 HIV-infected individuals and the median number of questionnaires completed per individual was five. There was no evidence of an increase in reported unsafe sex over time in this population [odds ratio (OR), 1.0; 95% confidence interval (CI), 0.96–1.05]. Females (OR, 1.38; 95% CI, 1.19–1.60), 15–30 year olds (OR, 1.26; 95% CI, 1.09–1.47), those with HIV-positive partners (OR, 12.58; 95% CI, 10.84–14.07) and those with occasional partners (OR, 3.25; 95% CI, 2.87–3.67) were more likely to report unsafe sex. There was no evidence of a response bias over time, but individuals were less willing to leave questions about their sexual behaviour unanswered or ambiguous (OR, 0.93; 95% CI, 0.90–0.97).

Conclusions: There was no evidence of a trend in unsafe sex behaviour over time. However, several subgroups were identified as being more likely to report unsafe sex and should be targeted for specific interventions. © 2004 Lippincott Williams & Wilkins

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Introduction

Increasing numbers of new HIV infections and sexually

transmitted diseases have been reported in North America, Australia and many countries in Western Europe [1]. There is also evidence that the epidemic

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itself is changing, with a larger proportion of new diagnoses occurring through heterosexual intercourse. In Western Europe, a large share of these heterosexually transmitted infections are being diagnosed in persons who have lived in, visited or originated from areas where the prevalence of HIV is high. In 2002, heterosexual contact accounted for 44% of new HIV diagnoses and 78% of these were in immigrants, mostly from sub-Saharan Africa [2]. In high-income countries, the epidemic is shifting into young, poor and disadvantaged groups of society, including ethnic minorities [1].

In addition to the problems associated with migration, there is some concern among public health authorities and epidemiologists that the availability and achievements of antiretroviral therapy (ART) in high-income countries may encourage unsafe sexual behaviour through a decrease in the perceived risk of sexual transmission of HIV [3–5]. Some studies have supported this claim and found that the rate of unprotected sex increased among individuals taking ART and among those with suppressed HIV RNA [6–8]. However, other studies have not found an increase in unprotected sex among those on ART regardless of any changes in perception regarding risk of transmission [9–11].

In 2001 in Switzerland, an increase of 7.7% in the number of new HIV infections marked the first rise since 1992. The increase was even more pronounced in 2002 (25.5%, 161 cases). Most of these new cases were sexually transmitted: 37% from homosexual transmission in mostly Swiss citizens and 26% from heterosexual transmission in those immigrating from sub-Saharan nations [12,13]. Between 2001 and 2003, the number of new cases of gonorrhoea and chlamydial infection also increased from 6.4 to 7.3/100 000 and 36 to 48.2/100 000, respectively [14].

The Swiss HIV Cohort Study (SHCS) prospectively records information on unsafe sexual behaviour in the same individuals over time. Changes in self-reported unsafe sexual behaviour in this cohort from 2000 to 2003 have been estimated. Our primary hypothesis was that unsafe sex did not increase during this time. If any changes in unsafe sex behaviour were observed, we hypothesized that they could be attributed to changes in the composition of the cohort over time. The nature of the data allowed powerful analysis techniques to be used to explore time trends in unsafe sexual behaviour.

Methods

Patients and definitions

Data come from the SHCS, a prospective cohort study of HIV-infected individuals aged 16 years or older

living in Switzerland. Patients are followed every 6 months in seven clinical centres in Switzerland. On 1 April 2000, a new questionnaire was introduced into the follow-up schedule with questions concerning the sexual behaviour of individuals during the last 6 months. Individuals were asked questions about their sexual behaviour during face-to-face interviews with their nurse or doctor (Fig. 1). Answers to these questions were voluntary.

The study population included patients who were registered and not known to have left the cohort prior to 1 April 2000 as well as new registrations until 1 April 2003. Patients who completed at least one sexual behaviour questionnaire were included in the analysis. A previous cross-sectional analysis explored the prevalence of unsafe sexual behaviour in the SHCS during the first year the questionnaire was released [15].

'Reported unsafe sex' was defined as not always using condoms during sexual intercourse. 'Denied unsafe sex' was defined as having no partner, abstaining from sexual intercourse with a partner or always using condoms during sexual intercourse. 'Possible unsafe sex' was defined as those who neither reported nor denied unsafe sex, and it was used as a proxy for evasiveness in reporting. Our primary outcome was 'reported unsafe sex', but the outcome 'did not deny unsafe sex' was also considered in a sensitivity analysis. Comparing results from both outcomes allowed a possible reporting bias to be explored.

Both time-independent and time-dependent clinical and demographic information were included in the model. Gender, age in the year 2000, ethnicity, education and HIV transmission group were all time-independent covariates. Time-dependent covariates were having an HIV-infected partner, having occasional partners, living alone, progression to an AIDS-defining opportunistic illness (as defined by 1993 Center for Disease Control and Prevention AIDS surveillance case definition), having optimal viral suppression, receiving ART and having an interruption in ART.

Progression to an AIDS-defining illness or having an interruption in ART were modelled by a discrete variable with the value 0 before its occurrence and 1 thereafter. Therefore, the coefficients for these variables estimated the long-term effect of progression to AIDS and the first interruption in ART, respectively.

If patients were taking ART at any time since their last follow-up visit, even if there was an interruption in therapy, then they were considered to be 'receiving ART'. Optimal viral suppression was defined as having a plasma HIV RNA (viral load) < 50 copies/ml allowing for an occasional blip (≥ 50 but ≤ 400 copies/ml). Two consecutive blips or a viral load > 400 copies/ml

- Set 1
1. Have you had a stable partnership in the last 6 months?
Possible answers: Yes, No, will not/cannot answer.
If answer is Yes
 2. Have you had vaginal or anal intercourse with this partner in the last 6 months?
Possible answers: Yes, No, will not/cannot answer.
If answer is Yes
 3. Did you use condoms during sexual intercourse?
Possible answers: always, occasionally, never, will not/cannot answer.
 4. Do you know if your stable partner is HIV positive?
Possible answers: positive, negative, I don't know, will not/cannot answer.
- Set 2
1. Have you had an occasional partner in the last 6 months?
Possible answers: Yes, No, will not/cannot answer.
If answer is Yes
 2. Have you had vaginal or anal intercourse with this partner in the last 6 months?
Possible answers: Yes, No, will not/cannot answer.
If answer is Yes
 3. Did you use condoms during sexual intercourse?
Possible answers: always, occasionally, never, will not/cannot answer.

Fig. 1. Follow-up questionnaire on sexual behavior for the Swiss HIV Cohort Study (in use since 1 April 2000). Questions are asked by a physician or nurse.

was considered non-optimal viral suppression. Patients were considered optimally virally suppressed if they had optimal viral suppression at all times since their previous follow-up visit.

In order to estimate any change in sexual behaviour, the variable 'time since 1 April 2000' was included as a key variable in the model. A significant non-zero estimate for this predictor was considered evidence that unsafe sexual behaviour was increasing or decreasing over time.

The primary hypothesis of this analysis was that unsafe sexual behaviour in the SHCS had not increased since 1 April 2000. The secondary hypothesis was that if any changes in sexual risk behaviour were observed, they could be explained by changes in the composition of the cohort over time. Based on the trends in HIV infection in Switzerland [12,13], behavioural changes with regard to sexual risk behaviour were not expected, but rather potential changes in the compositional structure of the HIV-positive population.

Statistical methods

The goal of this longitudinal data analysis was to estimate any change in safe sex behaviour over the 3-year period. Because safe sex behaviour in HIV-positive individuals was of interest from a public health perspective, trends in unsafe sexual behaviour in the population of HIV-positive individuals were explored

by fitting a fixed-effects model. The results then explained trends over time in the group of HIV-positive individuals as a whole, not in any one individual.

The first step was to look for any change in reported unsafe sex over time in a univariate analysis. The next step was to fit multivariate models adjusting for both time-independent and time-dependent covariates. If there was any evidence of residual change in unprotected sex over time, any changes in the composition of the cohort over time would be explored. This would be accomplished by including interactions between time and the covariates in a multivariate model. Logistic regression models were fitted using generalized estimating equations, an iterative fitting process, in SAS 8.2 (SAS Institute, Cary, North Carolina, USA). A constant correlation between responses from the same individual was assumed. This method calculates the association between the outcome and covariates using Wald tests. Estimates of the nature of the association between the outcome and explanatory variables were presented with odds ratios (OR) and 95% Wald confidence intervals (CI).

In order to assess whether there was any change in those responding to the questionnaire over time, a logistic regression model was fitted with the outcome 'completed at least one questionnaire during the year'. This was done for all 3 years of the study starting from

1 April 2000. This outcome definition allows for some flexibility in the scheduling of the semi-annual follow-up visits.

Results

From 1 April 2000 until 31 March 2003, 6553 individuals were followed in the SHCS. Of these, 6550 had at least one follow-up appointment and 6545 (99.9%) completed at least one questionnaire. Of the 4680 patients who were followed over all 3 years, 4369 (93%) had at least one follow-up appointment in all 3 years. The demographics of the study population were summarized by response pattern: those who always completed, sometimes completed and never completed the sexual behaviour questionnaires (Table 1). Females, those with basic education and intravenous drug users were less likely to always respond. The possibility of a response bias was assessed and no evidence was found of a change over time in patients' willingness to answer the questionnaire.

Patient characteristics were also summarized by year of participation in the study, with the first full year beginning on 1 April 2000 (Table 2). The population remained largely the same over time, but there was a

slight but steady increase in the percentage of 15–30 year olds, Caucasians, heterosexuals (with a corresponding decrease in the percentage of intravenous drug users) and those on continuous ART. Over the 3-year study period, the prevalence of reported unsafe sex ranged between 12.8 and 13.5% (Table 3).

In a univariate analysis, reported unsafe sexual behaviour was not found to be significantly changing over time (OR, 0.97; 95% CI, 0.94–1.00). After adjusting for all other covariates in a multivariate analysis, the OR for yearly change in reported unsafe sex since 1 April 2000 was 1.0 (95% CI, 0.96–1.05). Reported unsafe sex was not associated with ethnicity, intravenous drug use, education or having optimal viral suppression (Table 4). Reported unsafe sex, however, was associated with age, gender, having an HIV-positive stable partner, having occasional partners, living alone, having an AIDS-defining illness, taking ART and having an interruption in ART. Unsafe sex was more likely to be reported by individuals aged 15–30 years (OR, 1.26; 95% CI, 1.09–1.47), females (OR, 1.38; 95% CI, 1.19–1.60), individuals with HIV-infected partners (OR, 12.58; 95% CI, 10.84–14.07) and individuals with occasional partners (OR, 3.25; 95% CI, 2.87–3.67). Unsafe sex was less likely to be reported by individuals aged over 40 years (OR, 0.75; 95% CI, 0.65–0.87), homosexuals (OR, 0.69; 95% CI,

Table 1. Demographics by response group of HIV-infected individuals responding to the safe sex questionnaire in the Swiss HIV Cohort Study.

	Always respond (%)	Sometimes respond (%)	Never respond (%) ^a
Total (n = 6553)	6435 (98.2)	110 (1.7)	8 (0.1)
Gender			
Female	31	37	37.5
Male	69	63	62.5
Age in 2000 (years)			
15–30	15	14.5	12.5
31–40	48	54.5	50
≥ 41	37	31	37.5
Ethnicity			
Caucasian	73	68	75
Non-Caucasian	14	8	12.5
Unknown	13	24	12.5
Education			
Higher	67	53	62.5
Basic	26.6	38	37.5
Other/unknown	6.4	9	0
HIV transmission group			
Intravenous drug use	26	39	62.5
Homosexual	34	28.2	25
Heterosexual	36	27.3	12.5
Other	4	5.5	0
Continuous antiretroviral therapy	52	54	37.5
Optimal viral suppression ^b			
Yes	29	25	37.5
No	71	75	25
Unknown	0	0	37.5

^aThis includes patients who did not have any follow-up appointments during the study period, but were still registered in the cohort.

^bFor definition, see Methods.

Table 2. Demographic characteristics of HIV-infected individuals in the Swiss HIV Cohort Study in the years 2000 through 2003^a.

	Year 1 (%)	Year 2 (%)	Year 3 (%)
Total ^b	5310 (81)	5443 (83)	5585 (85)
Gender			
Female	30	31	31
Male	70	69	69
Age in 2000 (years)			
15–30	12	13	15
31–40	49	49	48
≥ 41	39	38	38
Ethnicity			
Caucasian	73	74	76
Non-Caucasian	12	13	14
Unknown	15	13	10
Education			
Higher	68	67	68
Basic	25	26	26
Other/unknown	7	7	6
HIV transmission group			
Intravenous drug use	27.5	25	24
Homosexual	35	35	36
Heterosexual	34	36	37
Other	3.5	4	4
Continuous antiretroviral therapy	53	54	56
Optimal viral suppression ^c	31	29	29
HIV infected partner ^d	12.8	13.1	12.9
Occasional partner ^d	19.5	20.3	20
Living alone ^d	42.6	42.1	41.6
AIDS ^d	25.8	24.8	24.1

^aYear 1 is from 1 April 2000 to 31 March 2001; year 2 is from 1 April 2001 to 31 March 2002; year 3 is from 1 April 2002 to 31 March 2003.

^bOnly those patients who were active participants in the SHCS during that year and responded to at least one follow-up appointment in that year are included.

^cFor definition, see Methods.

^dFor those patients who completed more than one questionnaire during the year, the response on the last questionnaire that year was used.

Table 3. Safe sex behaviour for individuals in the Swiss HIV Cohort Study in the years 2000 through 2003^a.

	Year 1 [No. (%)]	Year 2 [No. (%)]	Year 3 [No. (%)]
Total responses ^b	8956 (32)	9254 (33)	9669 (35)
Reported unsafe sex ^c	1149 (12.8)	1208 (13.1)	1304 (13.5)
Reported unsafe sex with an HIV-positive stable partner ^d	575 (50)	618 (51.2)	676 (51.8)
Possible unsafe sex ^e	532 (5.9)	382 (4.1)	399 (4.1)
Denied unsafe sex ^f	7275 (81.2)	7664 (82.8)	7966 (82.4)

^aYear 1 is from 1 April 2000 to 31 March 2001; year 2 is from 1 April 2001 to 31 March 2002; year 3 is from 1 April 2002 to 31 March 2003.

^bOnly those patients who were active participants in the SHCS during that year and responded to at least one follow-up appointment in that year are included. All responses by all individuals during the year are included.

^cTotal number of questionnaires that reported unsafe sex, regardless of HIV status. Reported unsafe sex is defined as those who did not always use condoms during sex.

^dOf those who reported unsafe sex, the subset of individuals with a stable partner who they knew to be HIV positive.

^eDefined as those who neither reported nor denied unsafe sex.

^fDefined as those who did not have a partner, did not have sex with their partner or always used condoms during sex.

0.58–0.82), individuals living alone (OR, 0.59; 95% CI, 0.53–0.67), individuals with an AIDS-defining illness (OR, 0.85; 95% CI, 0.73–0.98), individuals taking ART (OR, 0.57; 95% CI, 0.51–0.64) and individuals with at least one interruption in ART (OR, 0.85; 95% CI, 0.74–0.98).

The interaction between gender and the intravenous drug transmission group was included to explore the association between female drug users and unprotected sex. In this model, there was evidence that female drug users were more likely to report unsafe sex ($P < 0.01$) and gender was now only marginally associated with

Table 4. Association between unsafe sexual behaviour and demographics and treatment characteristics in the Swiss HIV Cohort Study.

Predictor	Reported unsafe sex		Did not deny unsafe sex	
	Adjusted odds ratio (95% CI) ^a	P value	Adjusted odds ratio (95% CI) ^a	P value
Gender		< 0.01		< 0.01
Female	1.38 (1.19–1.60)		1.26 (1.12–1.43)	
Male	1.00 (ref.)		1.00 (ref.)	
Age in 2000 (years)		< 0.01		≤ 0.01
15–30	1.26 (1.09–1.47)		1.19 (1.04–1.36)	
31–40	1.00 (ref.)		1.00 (ref.)	
≥ 41	0.75 (0.65–0.87)		0.83 (0.74–0.93)	
Ethnicity		0.15		0.08
Other	1.14 (0.95–1.6)		1.15 (0.98–1.34)	
Caucasian or unknown	1.00 (ref.)		1.00 (ref.)	
Education		0.44		0.02
Higher	0.95 (0.83–1.08)		0.88 (0.79–0.98)	
Basic or unknown	1.00 (ref.)		1.00 (ref.)	
HIV transmission group		< 0.01		0.46
Homosexual	0.69 (0.58–0.82)		1.05 (0.92–1.21)	
Intravenous drug use	1.02 (0.87–1.19)	0.84	0.99 (0.87–1.13)	0.88
Heterosexual, other, Unknown ^b	1.00 (ref.)		1.00 (ref.)	
HIV infected partner		< 0.01		< 0.01
Yes	12.58 (10.84–14.07)		6.9 (6.15–7.75)	
No or unknown	1.00 (ref.)		1.00 (ref.)	
Occasional partners		< 0.01		< 0.01
Yes	3.25 (2.87–3.67)		1.41 (1.26–1.58)	
No or Unknown	1.00 (ref.)		1.00 (ref.)	
Living Alone		< 0.01		< 0.01
Yes	0.59 (0.53–0.67)		0.86 (0.78–0.94)	
No or unknown	1.00 (ref.)		1.00 (ref.)	
AIDS		0.03		< 0.01
Yes	0.85 (0.73–0.98)		0.81 (0.72–0.91)	
No or unknown	1.00 (ref.)		1.00 (ref.)	
Antiretroviral therapy		< 0.01		< 0.01
Yes	0.57 (0.51–0.64)		0.58 (0.53–0.64)	
No or unknown	1.00 (ref.)		1.00 (ref.)	
First interruption of antiretroviral therapy		0.03		0.04
Yes	0.85 (0.74–0.98)		0.89 (0.79–0.99)	
No or unknown	1.00 (ref.)		1.00 (ref.)	
Optimal viral suppression ^c		0.51		0.54
Yes	0.97 (0.88–1.07)		1.03 (0.95–1.11)	
No or unknown	1.00 (ref.)		1.00 (ref.)	
Time since 1 April 2000		0.95		< 0.01
	1.00 (0.96–1.05)		0.93 (0.90–0.97)	

CI, confidence interval.

Total n = 6545

^aAdjusted for all other predictors listed in the table.

^bHeterosexual 91%, Other 9%

^cFor definition, see Methods.

the response ($P = 0.05$). When the interaction was utilized as a replacement for gender and intravenous drug transmission group in the multivariate analysis, female drug users were more likely to report unsafe sexual behaviour (OR, 1.73; 95% CI, 1.38–2.18).

In a univariate analysis with 'not denying unsafe sexual behaviour' as the response, there was evidence of a significant decrease over time (OR, 0.92; 95% CI, 0.89–0.95) that persisted in multivariate analyses including time-independent and time-dependent covariates. In the full model, the OR of the yearly change in 'not denying unsafe sexual behaviour' was 0.93 (95% CI, 0.90–0.97). Compared with reported unsafe sex, there was more evidence of an association between not

denying unsafe sex and education level (OR, 0.89; 95% CI, 0.79–0.98). In addition, homosexuals were less likely to report unsafe sex (OR, 0.69; 95% CI, 0.58–0.82) but were no less likely to not deny it (OR, 1.05; 95% CI, 0.92–1.21). Otherwise, the two analyses yielded consistent results with the remaining covariates having similar OR and CI values (Table 4).

Discussion

In this study, we did not find any evidence of an increase in reported unsafe sexual behaviour from 2000 to 2003. We did, however, find a significant decrease

in not denying unsafe sex, corresponding to a decrease in possible unsafe sex behaviour. We explored individuals' willingness to fill out the questionnaire and found no change in response bias across study years. These two findings imply that individuals are not becoming less likely to answer the questionnaire but are becoming less likely to leave questions as to their sexual behaviour unanswered or ambiguous.

In general, the prevalence of unsafe sexual behaviour was much lower in individuals in the SHCS compared with other studies of HIV-positive and HIV-negative individuals [16–18]. It is unclear how much of this discrepancy can be accounted for by potential under-reporting of unsafe sex in the SHCS. As in the previous cross-sectional study, there was no evidence to support the hypothesis that individuals taking ART and those with optimal viral suppression are more likely to engage in unsafe sexual behaviour [15]. In fact, this analysis found that those on ART and those with an interruption in ART were less likely to report unsafe sex behaviour. This result adds to the growing debate regarding the role of ART on perceptions of infectiousness and sexual risk behaviour [6–8,10,11].

Several factors were found to be associated with unsafe sexual behaviour. Females, those age 15–30 years, those with HIV-positive stable partners and those with occasional partners were more likely to report unsafe sex. Females from the intravenous drug transmission group were also more likely to report unsafe sex. It could be that female drug users face difficulties in negotiating condom use or that they are selling unsafe sex for drugs [2,19].

We found two suggestions of reporting bias. Those in the homosexual transmission group were less likely to report unsafe sex but just as likely to not deny unsafe sex. This suggests that homosexuals are less comfortable than heterosexuals in admitting to unsafe sex. In addition, those with higher education were no less likely to report unsafe sex but they were less likely to not deny it. This follows the general trend of individuals being less willing to leave the question of their sexual behaviour unanswered.

Our study had several limitations. First, sexual behaviour was self-reported during an interview with the individual's nurse or doctor. Patients may not have felt comfortable admitting to having unprotected sex in this environment, resulting in under-reporting. However, it was the specific goal of the investigators to provide regular opportunities for care-givers and patients to discuss issues of safe sex behaviour during semi-annual consultations. In addition, had the questionnaire been anonymous, our analysis would not have been so powerful for detecting change over time. Second, we found differences in those who always responded to the

questionnaire and those who did not. However, since 98.2% of patients always responded to the questionnaire and we have a sufficient sample size, there is little concern that the responses in this population would have significantly affected our results. Third, even though the SHCS includes a large percentage of women, heterosexuals and intravenous drug users, there may be important groups who are under-represented, such as immigrants. In addition, participants are intensely followed and may not be representative of individuals in Switzerland or elsewhere living with HIV. All three of these limitations could result in an under-estimation of the prevalence of unprotected sex both in the SHCS and in the wider community.

Our study also has several strengths. First, longitudinal data on the same individuals has allowed us to use more powerful statistical methods to analyse the data. Other studies have looked at changes in reported unsafe sexual behaviour among HIV-infected and uninfected individuals over time, but none of these studies was able to trace individuals from one time period to the next [9,16,20–23]. Second, we found no evidence of a bias in response across time. Third, we assessed the potential for reporting bias by utilizing two definitions of reported unsafe sex. Fourth, the SHCS is a large cohort, which gave us greater power to detect any relevant changes in unprotected sex. Lastly, the response rate was very high (99.9%) and suggests that the results are highly representative of individuals in the SHCS.

In conclusion, this study has provided relevant information about trends in unsafe sexual behaviour in the SHCS over time. The data and analysis shed light on important public health questions. Although there was no significant increase in reported unsafe sex in this population from 2000 to 2003, several subgroups were identified as being more likely continuously to report unprotected sexual behaviour. In addition, there were increasing numbers of individuals in the cohort from these high-risk subgroups, particularly young people and heterosexuals. This could translate into an increasing trend in unsafe sex in the future and continued increases in the incidence of sexually transmitted diseases and HIV infection. Public health campaigns and educational programmes to promote safe sex behaviour need to develop special programmes targeting individuals living with HIV who have high-risk behaviour for the transmission of HIV.

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Appendix

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