

Frequency and Determinants of Unprotected Sex among HIV-Infected Persons: The Swiss HIV Cohort Study

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(See the editorial commentary by Cohen on pages XXX–XXX.)

Background. Access to antiretroviral therapy may have changed condom use behavior. In January 2008, recommendations on condom use for human immunodeficiency virus (HIV)–positive persons were published in Switzerland, which allowed for unprotected sex under well-defined circumstances (“Swiss statement”). We studied the frequency, changes over time, and determinants of unprotected sex among HIV-positive persons.

Methods. Self-reported information on sexual preference, sexual partners, and condom use was collected at semi-annual visits in all participants of the prospective Swiss HIV Cohort Study from April 2007 through March 2009. Multivariable logistic regression models were fit using generalized estimating equations to investigate associations between characteristics of cohort participants and condom use.

Findings. A total of 7309 participants contributed to 21,978 visits. A total of 4291 persons (80%) reported sexual contacts with stable partners, 1646 (30%) with occasional partners, and 557 (10%) with stable and occasional partners. Of the study participants, 5838 (79.9%) of 7309 were receiving antiretroviral therapy, and of these, 4816 patients (82%) had a suppressed viral load. Condom use varied widely and differed by type of partner (visits with stable partners, 10,368 [80%] of 12,983; visits with occasional partners, 4300 [88%] of 4880) and by serostatus of stable partner (visits with HIV-negative partners, 7105 [89%] of 8174; visits with HIV-positive partners, 1453 [48%] of 2999). Participants were more likely to report unprotected sex with stable partners if they were receiving antiretroviral therapy, if HIV replication was suppressed, and after the publication of the “Swiss statement.” Noninjection drug use and moderate or severe alcohol use were associated with unprotected sex.

Conclusions. Antiretroviral treatment and plasma HIV RNA titers influence sexual behavior of HIV-positive persons. Noninjection illicit drug and alcohol use are important risk factors for unprotected sexual contacts.

Epidemiological data indicate that sexual risk behavior may have increased in recent years among human im-

munodeficiency virus (HIV)–positive men who have sex with men (MSM) [1–2], injection drug users (IDUs) [3], and heterosexual persons [4]. Before potent antiretroviral therapy (ART) was available, the most important prevention measure for transmission of virus in HIV-positive persons was condom use. There is a recent debate as to whether condom use is necessary if HIV replication is suppressed. In January 2008, Switzerland’s National HIV/AIDS Commission published recommendations on condom use (hereafter, the “Swiss statement”) stating that HIV-positive persons may discontinue condom use in a stable partnership if (1) their partners agreed, (2) if they were receiving ART, (3) if

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the viral load was suppressed to undetectable levels for at least 6 months, and (4) if other sexually transmitted infections were absent [5]. Consequently, ART status and plasma viral load may now influence sexual behavior in a stable partnership.

Alcohol use, injection and noninjection illicit drug use [6], and sex work [7] are associated with unprotected sexual contacts; sex with occasional partners or concurrency of different partners are associated with HIV infection and other sexually transmitted infections [8]. Different approaches to risk reduction, including serosorting (unprotected sex with occasional or stable partners who are believed to be seroconcordant) or negotiated safety (unprotected sex with a seroconcordant main partner) are of unproven efficacy [9, 10]. Their failure might explain new HIV infections among MSM.

To individualize HIV prevention, it is crucial to identify risks for unprotected sex. We studied the frequency of and determinants for unprotected sexual contacts, such as age, influence of ART, suppressed viral replication, illicit injection or noninjection drug use, and alcohol consumption on condom use. We analyzed self-reported condom use separately in MSM, heterosexual men, heterosexual women, and current IDUs, and we distinguished sexual contacts with stable versus occasional partners. In investigating participants of the Swiss HIV Cohort Study, we were also able to study the possible impact of the “Swiss statement” on the local HIV-positive population and their partners.

PATIENTS AND METHODS

Study design and data collection. Established in 1988, the Swiss HIV Cohort study (SHCS) is a prospective cohort study with continued enrolment of HIV-infected persons aged ≥ 16 years who attend outpatient clinics of 7 cohort centers, hospitals affiliated with centers, or private practitioners collaborating with the centers [11]. Standardized data collection forms containing demographic, psychosocial, clinical, laboratory, and treatment information are completed every 6 months by physicians and study nurses.

An interviewer-administered questionnaire on condom use (always; sometimes; never; no answer) of cohort participants, type of partners (stable vs occasional), and HIV serostatus (negative; positive; unknown) of stable partners within the last 6 months was introduced in April 2000. Serostatus of occasional partners was not elicited, because we did not expect reliable results. Questions on alcohol consumption were added in August 2005, and questions on injection and noninjection drug use were introduced in April 2007.

Study participants. All participants with at least 1 cohort visit from 1 April 2007 through 31 March 2009 with complete information on sexual behavior, drug use, participation in an opiate substitution program, alcohol intake, ethnicity, CD4⁺ cell

count, and HIV RNA level within 3 months prior to the cohort visit were included in the analyses. Cohort inclusion visits were excluded to avoid newly diagnosed HIV infections and, hence, to overestimate potentially unprotected sexual contacts within the preceding month. The protocol of the SHCS was approved by local ethical commissions, and written informed consent was obtained from all participants.

Definitions and measures. Initial analyses indicated that it was necessary to separate unprotected sexual contacts in stable partnerships from unprotected sexual behavior with occasional partners. In addition, an effect modification by sex and drug consumption behavior was observed. Participants were assigned to the group of MSM if their mode of HIV acquisition was homosexual sex. If they were infected by heterosexual contacts, they were assigned to the groups of heterosexual men or women. Male or female current IDUs and participants in an opiate substitution program within 3 years prior to the visit analyzed were categorized to the group of cIDU. Former IDUs who had completely abstained from IDU for at least 3 years and were not enrolled in an opiate substitution program and persons who solely consumed noninjection drugs were analyzed as heterosexuals or MSM depending on their sexual orientation. We defined unprotected sexual contacts as reporting that condoms were used sometimes or never since the last semi-annual cohort visit with (1) stable partners whose HIV status was reported to be negative or unknown or (2) with occasional partners.

To study the possible impact of the “Swiss statement”, which issued at the end of January 2008, we divided the observation period into 2 periods (1 April 2007 through 31 January 2008 and 1 February 2008 through 31 March 2009). Further analyses were made to differentiate whether there was an increase in unprotected sexual behavior close to the time of the “Swiss statement” or whether the increase was progressive during 2007–2009, and we looked at interactions between time periods and the effect of having a viral load below the level of detection.

ART status was categorized as (1) treatment-naive, (2) receiving ART with suppressed viral load (<40 copies/mL), and (3) receiving ART with detectable viral load (>40 copies/mL in different consecutive visits). Alcohol use was stratified according to the World Health Organization definition of severe (female subjects, >40 g/day; male subjects, >60 g/day), moderate (female subjects, 20–40 g/day; male subjects, 40–60 g/day), and light use (female subjects, <20 g/day; male subjects, <40 g/day). The term “cocktail” was used if participants consumed >1 noninjection drug. The term “any illicit drug” describes any injection or noninjection drug use.

Statistical analysis. Categorical variables were compared with use of the χ^2 test, and continuous variables were assessed with nonparametric methods (ie, Wilcoxon rank-sum test).

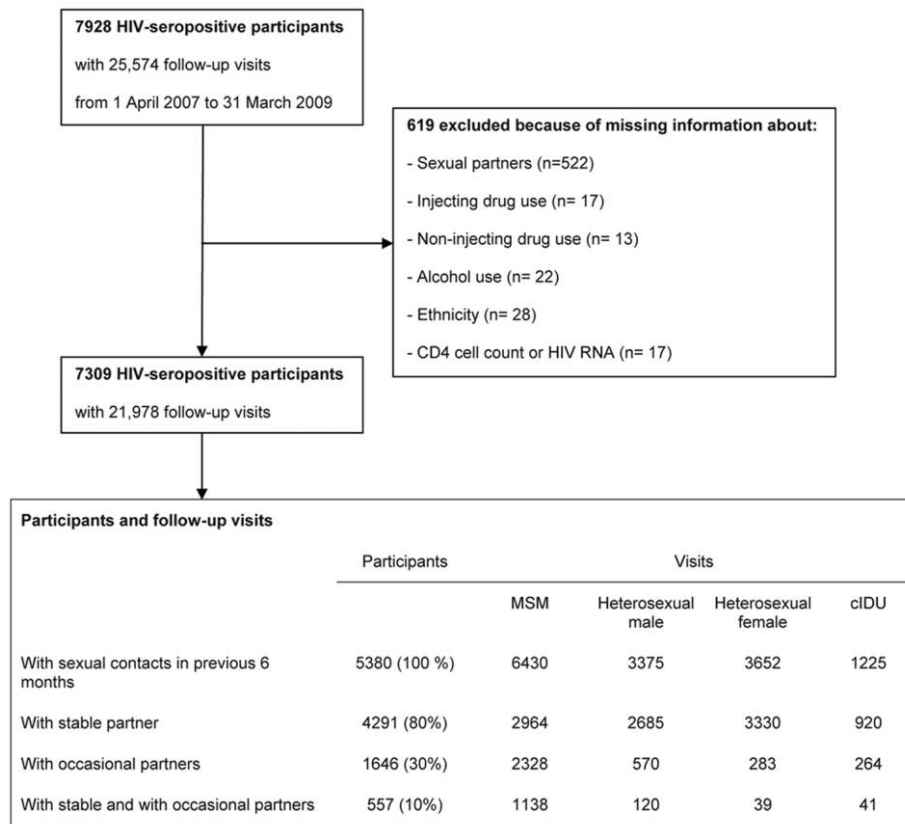


Figure 1. Patient flowchart. cIDU, current drug users or persons in an opiate substitution programme; HIV, human immunodeficiency virus; MSM, men who have sex with men.

Univariable and multivariable logistic regression models were fit using generalized estimating equations to determine the associations between unprotected sexual intercourse, age (per 10 years), calendar period before and after publication of the “Swiss statement”, ART use, alcohol consumption, and illicit drug use. The combined variable “any illicit drug use” could be analyzed in each of the 4 groups, but numbers for individual drugs, recently acquired syphilis, and ethnicity were too small in some groups, resulting in model instability of multivariable analyses.

Participants could contribute with different visits with potentially changed reported sexual behavior, illicit drug use, and ART status. Estimates of the associations between the outcome and variables are presented with odds ratios (ORs) and 95% confidence intervals (CIs).

We performed sensitivity analyses evaluating predictors of inconsistent condom use in stable partnerships once irrespective of the serostatus of the partner and once in seroconcordant couples. We used Stata software, version 11.0 (StataCorp), for analyses.

RESULTS

Selection and characteristics of cohort participants. The inclusion of SHCS participants is shown in Figure 1. From 1 April 2007 through 31 March 2009, a total of 7928 persons were observed. Of these, 619 were excluded because of incomplete information. Excluded individuals were more likely to be MSM (9% vs 7%), younger (median age, 39 vs 43 years), of nonwhite ethnicity (7% vs 12%), ART-naïve (19% vs 11%), have recently acquired syphilis (19% vs 8%), have consumed illicit drugs (13% vs 7%), or to be severe alcohol drinkers (11% vs 7%) ($P < .05$ for all). The 7309 selected participants contributed to 28,375 person-years of follow-up and 21,978 visits.

Characteristics of participants are summarized according to stratified groups in Table 1. The median age of all participants in the 4 groups was 43 years (interquartile range, 38–49 years). Nineteen percent (1355 of 7309 patients) were of nonwhite ethnicity, and among those patients, 838 (43%) were women. A total of 5838 (79.9%) of the participants were receiving ART, and 82% of these patients had an undetectable viral load at the

Table 1. Baseline Characteristics of 7309 Human Immunodeficiency Virus (HIV)–Seropositive Cohort Participants

Variable	No. (%) of participants				
	MSM (n = 2840)	Heterosexual men (n = 1650)	Heterosexual women (n = 1934)	cIDU (n = 885)	All (n = 7309)
Age					
16–29 Years	140 (5)	78 (5)	201 (10)	31 (4)	450 (6)
30–39 Years	666 (23)	306 (18)	648 (34)	224 (25)	1844 (25)
40–49 Years	1211 (43)	711 (43)	771 (40)	515 (58)	3208 (44)
50–59 Years	542 (19)	442 (21)	202 (10)	110 (12)	1196 (17)
≥60 Years	281 (10)	213 (13)	112 (6)	5 (1)	611 (8)
Nonwhite ethnicity					
	188 (7)	301 (18)	838 (43)	28 (3)	1355 (19)
Receiving ART					
HIV RNA level ≥40 copies/mL	378 (13)	242 (15)	252 (13)	150 (17)	1022 (14)
HIV RNA level <40 copies/mL	1825 (64)	1153 (70)	1286 (67)	552 (62)	4816 (66)
Alcohol use					
Light	1621 (57)	757 (46)	1803 (93)	435 (49)	4616 (63)
Moderate	89 (3)	90 (5)	107 (6)	71 (8)	357 (5)
Severe	39 (1)	31 (2)	23 (1)	61 (7)	11 (0)
New syphilis in study period					
	64 (2)	9 (0)	1 (0)	2 (0)	76 (1)
Opiate substitution					
	0 (0)	0 (0)	0 (0)	673 (76)	673 (9)
Any illicit drug use					
	211 (7)	42 (3)	17 (1)	349 (39)	619 (8)
Heroin use					
Noninjection	2 (0)	2 (0)	2 (0)	75 (8)	81 (1)
Injection	0 (0)	0 (0)	0 (0)	124 (14)	124 (2)
Cocaine use					
Noninjection	129 (5)	34 (2)	12 (1)	68 (8)	243 (3)
Injection	0 (0)	0 (0)	0 (0)	171 (19)	171 (2)
Cannabis use					
	341 (12)	228 (14)	119 (6)	342 (39)	1030 (14)
Use of poppers (alkyl nitrites)					
	28 (1)	0 (0)	0 (0)	0 (0)	28 (0)
Amphetamine use					
	78 (3)	9 (1)	0 (0)	7 (1)	99 (1)
Benzodiazepine use					
	0 (0)	0 (0)	0 (0)	37 (4)	39 (1)
γ-Hydroxybutyric acid use					
	20 (1)	0 (0)	0 (0)	3 (0)	23 (0)
Use of drug cocktail (multiple noninjection drugs)					
	27 (1)	1 (0)	0 (0)	2 (0)	30 (0)

NOTE. ART, antiretroviral therapy; cIDU, current injection drug user or persons in an opiate substitution program within 3 years of the visit analyzed; HIV, human immunodeficiency virus; MSM, men who have sex with men.

time of cohort visits. Among all participants, 63% reported alcohol consumption categorized as light, 5% reported moderate consumption, and 2% reported severe consumption. Consumption of illicit drugs was reported by 7% of MSM, by 3% of heterosexual men, and by 1% of heterosexual women. Among the cIDU group, 76% were in an opiate substitution program, and 39% reported use of any illicit drug.

Condom use. Figure 2 depicts data for MSM, heterosexual men, heterosexual women, and cIDUs regarding type of partners, HIV serostatus of partners, proportion of reported condom use, and proportion of participants with suppressed HIV RNA at the time of the cohort visit. Sexual contacts exclusively with stable partners were reported by MSM, heterosexual men, heterosexual women, and cIDUs in 46.1%, 79.8%, 91.2%, and

75.1% of cohort visits, respectively. Sexual contacts with both stable and occasional partners were reported by the different groups in 17.7%, 3.6%, 1.0%, and 3.4% of the visits, respectively, and sexual contacts with only occasional partners were reported in 36.2%, 16.9%, 7.8%, and 21.5% of the visits, respectively.

In all 4 groups of cohort participants, the rate of consistent condom use was lower with occasional partners than with stable partners (88% vs 92%; $P < .001$). The proportion of self-reported consistent condom use was 89% among participants with HIV-negative stable partners, 48% among those with HIV-positive stable partners, and 80% among those with occasional partners. Participants with only occasional partners reported consistent condom use in 87% (MSM), 93% (heterosexual

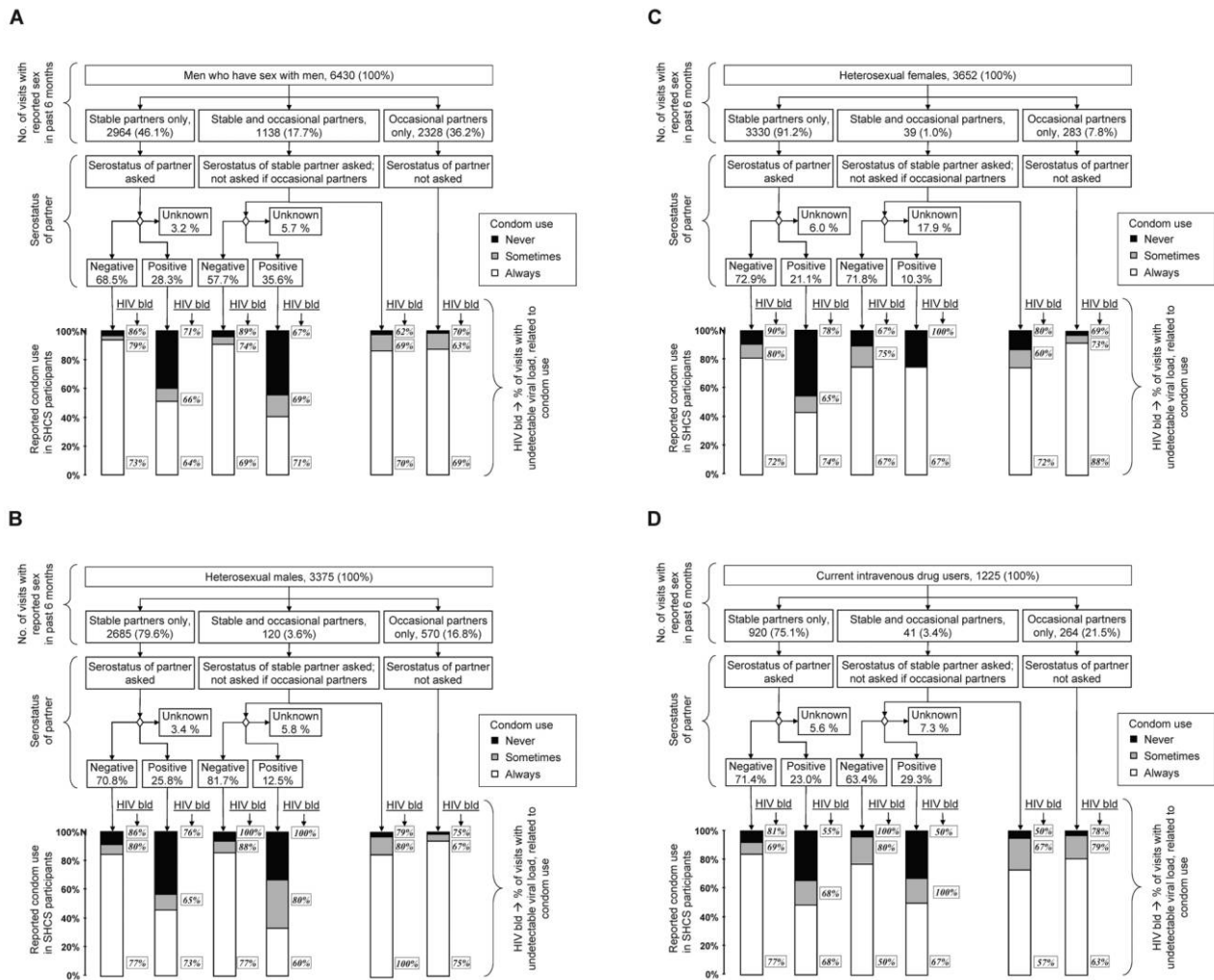


Figure 2. Results of 16,155 of 21,978 follow-up visits with information on type of sexual partners, human immunodeficiency virus (HIV) serostatus of sexual partners, reported condom use of Swiss HIV Cohort Study participants, and proportion of cohort participants with plasma HIV RNA below the level of detection, stratified into 4 groups. *A*, men who have sex with man. *B*, heterosexual men. *C*, heterosexual women. *D*, current intravenous drug users or persons in an opiate substitution programme. HIV bld, proportion of visits with HIV RNA below the level of detection, in relation to the respective reported condom use.

men), 91% (heterosexual women), and 80% (cIDUs) of visits. The proportion of visits at which participants had undetectable viral load is also shown in Figure 2.

Determinants of unprotected sexual contacts. Figure 3 shows results of univariable and adjusted multivariable analyses of risks for unprotected sexual contacts in the different groups of cohort participants, separated for participants with stable versus occasional partners. Unprotected sexual contacts were more likely to be associated with the following characteristics:

- Time period after the publication of the “Swiss statement” on condom use: all participant groups with stable partners, including MSM (OR, 1.88; 95% CI, 1.39–2.55), heterosexual men (OR, 1.53; 95% CI, 1.26–1.85), heterosexual women (OR, 2.04; 95% CI, 1.69–2.45), cIDUs (OR, 1.67; 95% CI,

1.17–2.38); and MSM with occasional partners (OR, 1.24; 95% CI, 1.03–1.48).

- Suppressed viral replication: MSM (OR, 2.41; 95% CI, 1.35–4.30) and heterosexual women with stable partners (OR, 2.73; 95% CI, 1.87–3.99).
- Younger MSM, irrespective of occasional (OR per 10 years older, 0.86; 95% CI, 0.75–0.99) or stable partnership (OR, 0.72; 95% CI, 0.59–0.87); younger heterosexual men (OR, 0.76; 95% CI, 0.65–0.91); women (OR, 0.77; 95% CI, 0.66–0.89), and cIDUs with stable partners (OR, 0.64; 95% CI, 0.41–0.97).
- Moderate or severe alcohol use: in heterosexual women (OR, 1.51; 95% CI, 1.05–2.17) and in cIDUs with stable partners (OR, 2.40; 95% CI, 1.48–3.87), and in heterosexual men with occasional partners (OR, 2.31; 95% CI, 1.12–4.77).

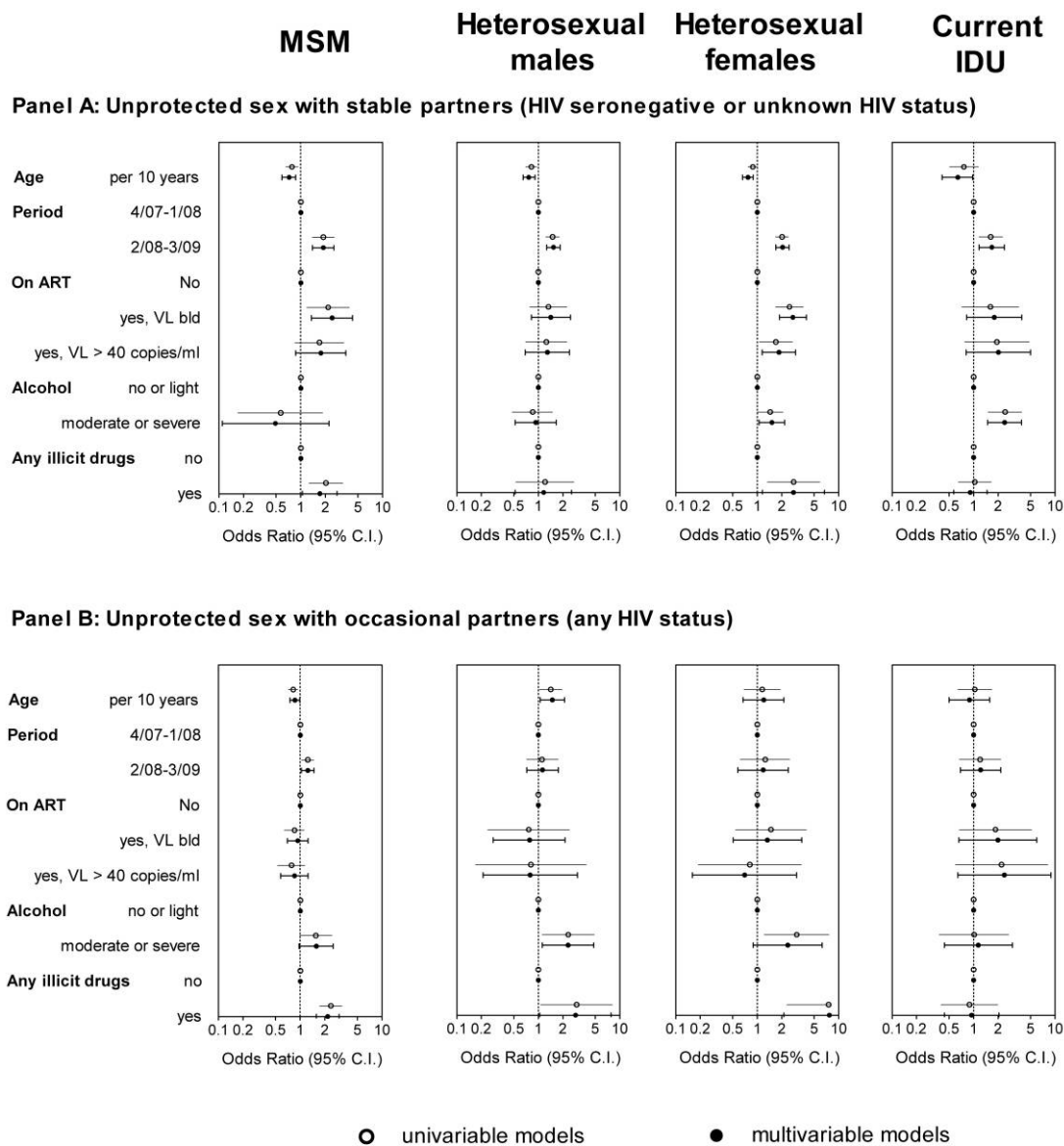


Figure 3. Results of univariable and multivariable analyses of risks for unprotected sex with stable partners (12,983 follow-up visits) (A) and with occasional partners (4889 follow-up visits) (B). Multivariable models were adjusted for all variables listed. ART, antiretroviral therapy; CI, confidence interval; IDU, injection drug use; MSM, men who have sex with men; VL bld, plasma HIV RNA load below the level of detection.

- Any illicit drug use: MSM (OR, 1.71; 95% CI, 1.05–2.78) and heterosexual women with stable partners (OR, 2.78; 95% CI, 1.16–6.68); and among groups with occasional partners, including MSM (OR, 2.85; 95% CI, 1.04–7.78), heterosexual men (OR, 2.94; 95% CI, 1.07–8.08), and heterosexual women (OR, 7.67; 95% CI, 2.13–27.57).

Associations between different illicit drugs and unprotected sexual contacts. In addition to the results of alcohol and drug use, as described in Figure 3, having unprotected sexual contacts was significantly associated with the following illicit drugs:

- Nasal cocaine in MSM with stable (OR, 2.72; 95% CI, 1.42–

5.18) and with occasional partners (OR, 2.55; 95% CI, 1.76–3.70).

- Cannabis (OR, 1.45; 95% CI, 1.07–1.98; $P = .071$), poppers (OR, 2.13; 95% CI, 1.29–3.52), methamphetamine (OR, 2.37; 95% CI, 1.58–3.60), γ -hydroxybutyric acid (OR, 2.44; 95% CI, 1.11–5.36), and drug cocktails (OR, 2.49; 95% CI, 1.24–5.00) in MSM with occasional partners.

- Cannabis (OR, 1.51; 95% CI, 1.09–2.08) among heterosexual men with stable partners.

Interactions between time periods and having a viral load below the level of detection. In all participant groups with

Table 2. Odds Ratios for Unprotected Sex in Stable Partnerships in Relation to the Publication of the “Swiss Statement” in Different Participant Groups

Group, period	Odds ratio (95% CI)	<i>P</i> ^a
MSM		<.001
April 2007–August 2007	0.56 (0.35–0.92)	
September 2007–January 2008	0.81 (0.54–1.22)	
February 2008–June 2008 ^b	1	
July 2008–October 2008	1.30 (0.93–1.82)	
November 2008–March 2009	1.63 (1.16–2.29)	
Heterosexual men		<.001
April 2007–August 2007	0.75 (0.59–0.96)	
September 2007–January 2008	0.83 (0.65–1.10)	
February 2008–June 2008 ^b	1	
July 2008–October 2008	1.32 (1.05–1.66)	
November 2008–March 2009	1.21 (0.96–1.52)	
Heterosexual women		<.001
April 2007–August 2007	0.58 (0.45–0.75)	
September 2007–January 2008	0.60 (0.47–0.77)	
February 2008–June 2008 ^b	1	
July 2008–October 2008	1.22 (1.00–1.51)	
November 2008–March 2009	1.34 (1.11–1.63)	
cIDU		.084
April 2007–August 2007	0.66 (0.42–1.03)	
September 2007–January 2008	0.63 (0.41–0.97)	
February 2008–June 2008 ^b	1	
July 2008–October 2008	1.01 (0.70–1.46)	
November 2008–March 2009	1.13 (0.75–1.68)	

NOTE. CI, confidence intervals; cIDU, current drug users or persons in an opiate substitution program; MSM, men who have sex with men.

^a Test for trend.

^b Reference period: publication of the “Swiss statement.”

stable partners, a progressive increase in unprotected sex could be observed over time, and interestingly, in MSM and heterosexual females, there was already a trend toward unprotected sex before January 2008 (Table 2).

The influence of the “Swiss statement” was markedly increased among MSM, heterosexual males, and heterosexual females with a stable partner receiving ART and a suppressed viral load (MSM: OR, 2.81 [95% CI, 1.37–5.80]; heterosexual males: OR, 1.58 [95% CI, 1.00–2.48]; heterosexual females: OR, 2.14 [95% CI, 1.43–3.22]). In cIDUs, only a trend was found (OR, 1.65; 95% CI, 0.92–2.99).

Sensitivity analyses. In concordant partnerships, having an HIV-positive stable partner was strongly associated with unprotected sex among all groups of cohort participants: the OR was 15.55 (95% CI, 12.36–19.56) for MSM, 6.77 (95% CI, 5.14–8.93) for heterosexual males, 6.88 (95% CI, 5.38–8.80) for heterosexual females, and 7.68 (95% CI, 4.98–11.84) for cIDUs. Analyzing inconsistent condom use in stable partnerships irrespective of the serostatus of the partner showed comparable results (Figure 3).

DISCUSSION

We found a substantial variation in condom use among HIV-positive participants in our large prospective observational cohort. The proportion of consistent condom use was 89% among participants with HIV-seronegative stable partners, 48% with HIV-seropositive stable partners, and 88% with occasional partners.

Whether ART may promote unprotected sexual intercourse has previously been discussed [12, 13]. In contrast to earlier results from our cohort, which did not find an association between viral load and sexual behavior [14, 15], we now observed an association of a suppressive ART and unprotected sexual contacts in MSM and heterosexual women with stable partners, indicating that some groups with HIV infection have adopted the belief that treatment of HIV infection is a sufficient HIV-prevention measure [16]. Precise estimates of the risk from unprotected intercourse when the infected person is receiving successful HIV treatment are not available [17, 18]. SHCS participants receiving successful ART who were observed in the year 2007 still had suppressed viral load in 91.9% at the next semi-annual follow-up visit, but 2.2% had discontinued treatment, and 5.9% had a viral rebound [19]. A model-based analysis calculated a cumulative probability of transmission to the serodifferent partner of 0.0022 per year [20]. Authors claimed a substantial increase in HIV infection incidence if the non-infectiousness of effectively treated patients was widely accepted, and hence, condom use decreased. However, there is increasing evidence that viral-suppressive ART reduces sexual infectiousness of HIV, and the World Health Organization thinks of expanding ART coverage to all people with a diagnosis of HIV infection in the purpose of HIV infection prevention [21].

We observed that the probability of reporting unprotected sexual contacts was increasing over time among cohort participants with stable partners, as well as among MSM with occasional partners. The effect of the “Swiss statement” was most pronounced in groups with stable partners who had an undetectable viral load, indicating that the Swiss population is able to accept such complex recommendations. Of note, the change of policy led, not to an increase in observed new HIV infections in Switzerland [22]. The association of unprotected sex and the “Swiss statement” either results from a change in the social acceptability of having sex without condoms after the publication of the “Swiss statement”, or the result may indicate a real change in sexual behavior. Our results show that there was already a trend toward unprotected sex before January 2008. Other studies have assessed time trends in the sexual practices of HIV-positive persons, but most of them did not find an increase in unprotected sexual intercourse over time [3, 14, 15, 23].

Cohort participants having relations with concordant part-

ners were more likely to report unprotected sexual contact [1]. Whether condom use is needed if both partners are HIV seropositive is controversial. Although rare cases of HIV superinfections have been described in persons with long-term HIV infection who are receiving ART, the risk of unprotected sexual contacts in individuals with a suppressed HIV RNA level seems low. However, unprotected sexual contacts are associated with transmission of other sexually transmitted diseases, which consecutively may lead to a transient increase in viral load in the genital compartment and temporarily may not only increase HIV transmission but also the risk for HIV superinfection [24].

As in other studies [14, 15, 23, 25], participants of older age, especially those in a stable partnership, were less likely to report unprotected sex. Similar to the Vespa Study [26, 27], we found that illicit noninjection drug consumption and alcohol use increased the risk for unprotected sexual contacts among MSM, heterosexual man, and heterosexual women with occasional partners. Alcohol use was associated with unprotected sexual contacts among cIDUs with stable partners, indicating the added danger when both substance dependence and alcohol use are present.

Possible limitations of our study are the uncertain accuracy of self-reported information on sexual behavior, illicit drug use, and alcohol consumption assessed by face-to-face interviews. A more anonymous mode of assessment (eg, computer-assisted interviewing or self-administered questionnaires) might have led to higher reporting of nonnormative and risky behavior. Underreporting of socially unacceptable sexual behavior or, in contrast, more-accurate reporting because of perceived changes in social acceptance of unprotected sexual contacts after publication of the “Swiss statement” may have influenced the answers of participants. The relation of patient and provider, their degree of confidence and trust, or the providers’ values, none of which were measured, may also have influenced our results. Furthermore, some participants with obvious high-risk behavior (eg, recently acquired syphilis) have refused to disclose details on sexual practices and thus were excluded from analyses. Another bias may have resulted from individuals with lifestyles associated with more-frequent unprotected sex and nonparticipation in the SHCS (eg, drug-addicted sex workers). Strengths of our study include its statistical power, because of the cohort’s size, and the prospective design, which allows analyses of time trends of unprotected sexual behavior and of changes in relation to the publication date of the “Swiss statement”. In contrast to others [23], we precluded a bias in reporting of unprotected sexual contacts by acutely HIV-infected persons by deleting cohort inclusion visits for analyses. We believe that our results are highly representative, because 93.4% of the cohort participants responded to questions on sexual behavior.

In conclusion, condom use by HIV-seropositive persons varies widely. Individualized counselling to prevent sexual HIV

transmission is part of patient care. More focus should be placed on patterns of alcohol and illicit drug use, which may not only improve adherence to ART but also prevent HIV transmission. Among persons with concurrent partners, counselling is needed to address other sexually transmitted infections [28], including hepatitis C virus infection [29], and the risk of increased sexual transmission of HIV in case of co-infections. Because ART influences sexual behavior in HIV serodifferent partners, adherence to treatment and plasma viral load should be regularly monitored in the HIV-positive partner, and counselling of couples should be advocated.

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