

Comparison of sexual behaviors, unprotected sex, and substance use between two independent cohorts of gay and bisexual men

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Objective: To compare demographic characteristics, sexual practices, unprotected receptive and insertive anal intercourse, substance use and rates of HIV-1 seroconversion between two prospective cohorts of HIV-negative men who have sex with men.

Design: Comparative analysis of two independent cohorts.

Methods: Between May 1995 and April 1996, 235 HIV-negative Vanguard Project (VP) participants were enrolled and between January and December 1985, 263 HIV-negative participants in the Vancouver Lymphadenopathy-AIDS Study (VLAS) completed a follow-up visit. The VP participants were compared with VLAS participants with respect to self-reported demographic variables, sexual behaviors, unprotected sex, substance use and rates of HIV-1 seroconversion during follow-up.

Results: In comparison with the VLAS participants the VP participants were younger (median age, 26 versus 34 years; $P < 0.001$), more likely to be non-Caucasian (75 versus 97%; $P < 0.001$), and were less likely to have attended university/college (35 versus 46%; $P = 0.014$). The VP participants reported a higher mean number of male sex partners in the previous year (15 versus 12; $P = 0.026$) and a higher mean number of regular partners (1.7 versus 0.6; $P < 0.001$). The VP participants were more likely to report engaging in receptive (92 versus 60%; $P < 0.001$) and insertive (90 versus 69%; $P < 0.001$) anal intercourse with regular partners and receptive anal intercourse with casual partners (62 versus 38%; $P < 0.001$). The VLAS participants were more likely to report never using condoms during insertive and receptive anal intercourse with both regular and casual partners. The VP participants were less likely to report using nitrite inhalants (34 versus 43%; $P = 0.033$), but more likely to report the use of cocaine (30 versus 8%; $P < 0.001$), LSD (21 versus 3%; $P < 0.001$), amphetamine (11 versus 1%; $P < 0.001$), heroin (3 versus 0%; $P = 0.010$) and methyldiamphetamine (17 versus 10%; $P = 0.034$). The VLAS participants were nine times more likely to report high-risk sexual behavior, after controlling for differences in age, ethnicity, substance use, and method of recruitment between cohort members. After adjustment for differences in demographics, sexual behaviors, and level of substance use, the risk ratio for seroconversion among VLAS participants remained significantly elevated compared with VP participants.

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Conclusion: These data provide evidence that men who have sex with men who were enrolled in the VP were more sexually active than their VLAS counterparts were 10 years ago as measured by self-reported numbers of regular and casual partners and frequency of anal intercourse with these partners. However, condom use appears to be significantly higher among VP participants, which has contributed to a lower rate of HIV-1 infection.

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Introduction

In Canada, men who have sex with men (MSM) have been seriously affected by the HIV epidemic. In 1985, 83% of all reported AIDS cases among adult males occurred in this population. By 1995, the percentage of all reported cases in this category had decreased to 74% [1]. Despite this reduction, MSM have remained greatly affected by the HIV/AIDS epidemic. Sexual transmission among MSM continues to be a major source of new HIV infections in Canada.

Since the mid 1980s, prevention efforts in Canada have focused on the promotion of safer sex practices which aim to reduce and/or eliminate the frequency of activities which pose the highest risk for HIV acquisition and transmission. This risk-reduction approach attempts to communicate to individuals the behaviors that are more likely to reduce their risk of HIV acquisition. Within this model, various sexual practices have been designated as high risk, low risk, theoretical risk, and no risk for HIV transmission. For example, among MSM, unprotected, receptive or insertive anal intercourse is considered a very high-risk sexual practice [2].

Although prevention programs initially met with some success [3–5], studies reviewing the consistency of safer sexual practices at the individual level are less encouraging [3,6,7]. These findings have led to concerns that prevention programs have not addressed the issue of a return to higher risk sexual behaviors. Moreover, 15 years after the beginning of the HIV/AIDS epidemic, young MSM may be engaging in higher risk behaviors than older MSM [8–11]. These findings suggest that young MSM may be at increased risk of HIV infection at a time when risk-reduction strategies have been widely promoted [12].

In this study, we compared HIV seroconversion rates, self-reported demographic characteristics, sexual practices, condom use, and substance use between two independent cohorts of men having sex with men during two time periods approximately 10 years apart. Analyses such as these can contribute to an improved

understanding of trends in sexual risk behaviors and substance use over time. Furthermore, such comparative analyses can provide both important benchmarks for evaluating the impact of prevention programs on high risk behaviors in targeted populations affected by the HIV epidemic and used to develop performance indicators for prevention service providers.

Materials and methods

The Vanguard Project (VP) is an ongoing prospective study of over 750 gay and bisexual men aged 18 to 30 years, living in the Greater Vancouver region. The Participants were recruited through outreach, medical clinics, and physicians' offices. Eligibility criteria for this longitudinal study required that participants had not previously tested positive for HIV and that they self-identified as gay or bisexual or had sex with other men. Since May 1995, VP participants have completed self-administered questionnaires and undergone HIV testing on an annual basis. The questionnaires elicited information on socio-demographic traits characteristics, sexual behavior, and substance use in addition to other variables. In addition, blood samples were drawn for HIV antibody testing.

The methods and aims of the Vancouver Lymphadenopathy-AIDS Study (VLAS) have been described elsewhere [13,14]. From November 1982 to December 1984, over 700 gay and bisexual men aged 18 to 75 years were recruited through six general practices in Vancouver. Follow-up visits occurred approximately every 6 months until September 1986, after which, subjects completed visits on an annual basis. During each visit participants completed a self-administered questionnaire which elicited information regarding socio-demographic characteristics, sexual practices, substance use and other variables. In addition, a physical examination was performed and blood samples were drawn for immunologic and HIV antibody testing.

The general objectives of these two longitudinal studies were similar in scope and included the contribution to

our understanding of the epidemiology of HIV and its modes of transmission, the natural history of HIV infection, the aetiology of AIDS, and its related clinical outcomes. Procedures of data collection for these studies were also similar in terms of the completion of self-administered questionnaires, HIV antibody testing, and the donation of a blood specimen for cryopreservation at each follow-up visit. However, these studies did differ with respect to their eligibility criteria, recruitment strategies, and the frequency of follow-up visits. In the VP, follow-up visits have occurred on an annual basis whereas the frequency of visits occurred on a bi-annual basis until September 1986 in the VLAS. In addition, VP participants were restricted to men who were between the ages of 18 and 30 years with the majority of participants being recruited through outreach and medical clinics whereas VLAS participants between the ages of 18 and 75 years were all recruited through general practitioners' offices.

Common variables were created from the survey instruments of both studies and were merged into a common coding scheme. Variables of interest these comparative analyses included: demographic characteristics such as age, ethnicity, income, and education; sexual behavior variables including the number of male sexual partners; frequency of receptive and insertive anal intercourse; frequency of condom use during anal intercourse; and use of tobacco, alcohol, and other drugs. Data concerning sexual behaviors and substance use pertained to self-reported behaviors which occurred during the previous 12 months. For sexual behavior variables, a distinction was made between sexual encounters with regular and casual partners. Regular partners were defined as those partners with whom the frequency of sexual encounters was at least once per month. Casual partners were defined as those partners with whom the frequency of sexual encounters was less than once per month. Questionnaire items regarding condom use differed between these studies. For these variables, different scales of measurement were used to measure the frequency of condom use. Because of these differences, we used the following categories for frequency of condom use during receptive or insertive anal intercourse: never, up to 30% of the time, 30 to 70% of the time, over 70% of the time.

To assess differences in sexual behaviors and other risk factors for HIV acquisition between these cohorts, we conducted cross-sectional comparative analyses. We compared 235 VP participants who were HIV negative when they completed their enrollment questionnaire during the period May 1995 to April 1996, and 263 VLAS participants who were HIV negative when they completed a follow-up visit during the period January to December 1985. For VLAS participants, we chose this follow-up visit for comparison because this was the earliest follow-up visit from which information about

condom use during specific sex acts or with specific types of partners was available. In order to account for the different age distributions between the cohorts at the time of questionnaire administration, we also performed a comparative analysis in which we restricted VLAS participants to those aged 18 to 30 at the time of the follow-up visit.

Categorical variables were compared between cohorts using Pearson's χ^2 test. Contingency tables that contained one or more expected counts of less than five were analyzed by Fisher's exact test. Comparisons of quantitative variables between cohorts were carried out using Wilcoxon's rank-sum test.

Multivariate logistic regression was used to assess the relationship between high-risk sexual behavior and cohort membership while controlling for differences in demographic variables, substance use, and the method of recruitment. In these models, a dichotomous dependent variable was defined *a priori* as follows. High risk participants were defined as those who reported practicing either receptive or insertive anal intercourse with one or more casual sexual partners during the previous 12 months, and who reported never using condoms during these sexual practices.

Kaplan–Meier methods were used to compare the cumulative seroconversion rate in both cohorts. In these analyses, time zero was defined as the date of questionnaire completion, and the estimated date of seroconversion was defined as the midpoint between the last negative and first positive HIV-1 antibody test result. Differences in cumulative seroconversion rates between cohorts were evaluated by stratified Kaplan–Meier survival analysis and compared using the log-rank test. Event-free individuals in both cohorts were censored after 42 months of follow-up. We also assessed the independent effect of cohort membership on time to seroconversion while controlling for potential confounding variables using Cox proportional hazards regression.

Results

Demographic characteristics

As seen in Table 1, VP participants were significantly younger than VLAS participants at the time the survey questionnaires were completed (median age 26 versus 34 years; $P < 0.001$), were more likely to be non-Caucasian (25 versus 3%; $P < 0.001$), and were less likely to have attended university or college (35 versus 46%; $P = 0.014$). Similar proportions of VP and VLAS participants reported annual incomes of less than \$10,000 (21 versus 20%; $P = 0.688$).

Table 1. Comparison of demographic characteristics between participants in the Vanguard Project (VP) and the Vancouver Lymphadenopathy-AIDS Study (VLAS).

	VP	VLAS	P-value
Age			
Median	26	34	< 0.001 ^a
Range	18–30	19–61	
Ethnicity			
Caucasian	176 (75%)	255 (97%)	< 0.001 ^b
Other	59 (25%)	8 (3%)	
Education (university/college)			
No	148 (65%)	142 (54%)	0.014 ^b
Yes	80 (35%)	121 (46%)	
Income			
< \$10,000/year	48 (21%)	52 (20%)	0.688 ^b
≥ \$10,000/year	178 (79%)	211 (80%)	

^aBased on Wilcoxon rank-sum test. ^bBased on Pearson's χ^2 test.

Sexual behaviors

Examination of sexual history data revealed that VP participants were more likely to report a higher number of male sex partners in the prior year (15 versus 12; $P = 0.026$). VP participants also reported more regular partners (1.7 versus 0.6; $P < 0.001$), however, the number of casual partners reported did not differ significantly between the cohorts (Table 2). VP participants were more likely to report receptive (92 versus 60%; $P < 0.001$) and insertive (90 versus 69%; $P < 0.001$) anal intercourse with regular partners compared with their VLAS counterparts. As seen in Table 3, VLAS participants were more likely to report never using condoms during both receptive anal intercourse (72 versus 15%; $P < 0.001$) and insertive anal intercourse (69 versus 17%; $P < 0.001$) with regular partners. VP participants were more likely than VLAS

Table 2. Comparison of self-reported numbers of sexual partners between participants in the Vanguard Project (VP) and the Vancouver Lymphadenopathy-AIDS Study (VLAS).

	VP	VLAS	P-value
Number of sexual partners during the previous year			
Mean	15.2	12.2	0.026 ^a
Standard deviation	32.5	24.9	
Median	5	4	
Range	0–400	0–196	
Number of regular sexual partners during the past year			
Mean	1.7	0.6	< 0.001 ^a
Standard deviation	2.8	0.6	
Median	1	1	
Range	0–30	0–3	
Number of casual sexual partners during the past year			
Mean	12.5	11.5	0.067 ^a
Standard deviation	21.2	24.9	
Median	4	4	
Range	0–120	0–194	

^aBased on Wilcoxon rank-sum test.

participants to report receptive anal intercourse with casual partners (62 vs. 38%; $P < 0.001$). There were no significant differences in the reported frequency of insertive anal intercourse with casual partners (Table 3). With respect to condom use, VLAS participants were more likely to report never using condoms with casual partners during receptive (59 versus 6%; $P < 0.001$) and insertive (58 versus 6%; $P < 0.001$) anal intercourse with casual partners compared with VP participants.

Substance use

Comparisons of participants from the two cohorts with respect to substance use revealed that VLAS participants were more likely to use nitrite inhalants or poppers (43 versus 34%; $P = 0.033$), but were less likely to use cocaine (8 versus 30%; $P < 0.001$), LSD (3 versus 21%; $P < 0.001$), amphetamines (1 versus 11%; $P < 0.001$), heroin (0 versus 3%; $P = 0.010$) and methylamphetamines (MDA) (10 versus 17%; $P = 0.034$). No significant differences in alcohol, marijuana/hash or tobacco use were observed (Table 4).

Age-restricted comparisons

In the sub-analysis in which we restricted the age range of VLAS participants to between 18 and 30 years, VP participants were more likely to be non-Caucasian (25 versus 1%; $P < 0.001$) and reported higher numbers of sexual partners during the previous year (15 versus 12; $P = 0.044$). Analysis of sexual behavior revealed that the men in VP were more likely to report engaging in receptive (92 versus 75%; $P < 0.001$) and insertive (90 versus 71%; $P < 0.001$) anal sex with regular partners compared with VLAS participants. Conversely, VLAS participants reported never using condoms during receptive (67 versus 15%; $P < 0.001$) and insertive (71 versus 17%; $P < 0.001$) anal sex more than their VP counterparts. Reporting of receptive and insertive anal sex with casual partners was not significantly different between the two cohorts in this age-restricted analysis. However, VLAS participants were more likely to report never using condoms during receptive (63 versus 6%; $P < 0.001$) and insertive (70 versus 6%; $P < 0.001$) anal intercourse with casual partners. VP participants were more likely to report using cocaine (30 versus 12%; $P < 0.001$), LSD (21 versus 4%; $P < 0.001$), and amphetamines (11 versus 2%; $P = 0.020$) compared to VLAS participants. The age restricted comparative analyses revealed similar rates of use for marijuana/hash, heroin, tobacco, alcohol, MDA, and nitrite inhalants.

Multivariate analysis: high-risk sexual behavior

Significantly more VLAS participants reported high-risk sexual behavior compared to those in the VP (30 versus 4%; $P < 0.001$). VLAS participants were 9.5 times more likely to report high-risk sexual behavior [95% confidence interval (CI), 4.8–18.8]. Because cohort

Table 3. Comparison of self-reported frequency of anal intercourse and condom use with regular and casual partners among participants in the Vanguard Project (VP) and the Vancouver Lymphadenopathy-AIDS Study (VLAS).

	VP n (%)	VLAS n (%)	P-value
Regular sexual partners			
Receptive anal intercourse ^a			
Never	13 (8)	59 (40)	< 0.001
< 30% of sexual encounters	63 (39)	52 (35)	
30–70% of sexual encounters	27 (17)	28 (19)	
> 70% of sexual encounters	59 (36)	8 (5)	
Total	162 (100)	147 (100)	
Condom use during receptive anal intercourse ^b			
Never	23 (15)	63 (72)	< 0.001
< 30% of sexual encounters	59 (40)	10 (11)	
30–70% of sexual encounters	23 (15)	3 (3)	
> 70% of sexual encounters	44 (30)	12 (14)	
Total	149 (100)	88 (100)	
Insertive anal intercourse ^a			
Never	16 (10)	46 (31)	< 0.001
< 30% of sexual encounters	55 (34)	46 (31)	
30–70% of sexual encounters	26 (16)	39 (26)	
> 70% of sexual encounters	65 (40)	16 (11)	
Total	162 (100)	147 (100)	
Condom use during insertive anal intercourse ^c			
Never	25 (17)	70 (69)	< 0.001
< 30% of sexual encounters	53 (36)	9 (9)	
30–70% of sexual encounters	22 (15)	10 (10)	
> 70% of sexual encounters	46 (32)	12 (12)	
Total	146 (100)	101 (100)	
Casual sexual partners			
Receptive anal intercourse ^d			
Never	71 (38)	114 (62)	< 0.001
< 30% of sexual encounters	55 (30)	49 (27)	
30–70% of sexual encounters	26 (14)	16 (9)	
> 70% of sexual encounters	33 (18)	5 (3)	
Total	185 (100)	184 (100)	
Condom use during receptive anal intercourse ^e			
Never	7 (6)	41 (59)	< 0.001
< 30% of sexual encounters	52 (46)	9 (13)	
30–70% of sexual encounters	25 (22)	3 (4)	
> 70% of sexual encounters	30 (26)	17 (24)	
Total	114 (100)	70 (100)	
Insertive anal intercourse ^d			
Never	59 (32)	72 (39)	< 0.001
< 30% of sexual encounters	59 (32)	58 (32)	
30–70% of sexual encounters	13 (7)	42 (23)	
> 70% of sexual encounters	54 (29)	12 (6)	
Total	185 (100)	184 (100)	
Condom use during insertive anal intercourse ^f			
Never	8 (6)	65 (58)	< 0.001
< 30% of sexual encounters	58 (46)	17 (15)	
30–70% of sexual encounters	12 (10)	11 (10)	
> 70% of sexual encounters	48 (38)	19 (17)	
Total	126 (100)	112 (100)	

^aRestricted to participants who reported having regular sexual partners in the previous 12 months. ^bRestricted to participants who reported receptive anal intercourse with regular partners in the previous 12 months. ^cRestricted to participants who reported insertive anal intercourse with regular partners in the previous 12 months. ^dRestricted to participants who reported having casual sexual partners in the previous 12 months. ^eRestricted to participants who reported receptive anal intercourse with casual partners in the previous 12 months. ^fRestricted to participants who reported insertive anal intercourse with casual partners in the previous 12 months.

membership was likely to be confounded with differences in demographics, level of substance use, and the method of study recruitment, we used multivariate logistic regression to model the simultaneous effect of

these variables on self-reported high-risk sexual behavior. The results of this multivariate model are presented in Table 5. As seen here, membership in the VLAS cohort had an adjusted odds ratio of 9.2 (95%

Table 4. Comparison of self-reported use of tobacco, alcohol and illicit drugs among participants in the Vanguard Project (VP) and the Vancouver Lymphadenopathy-AIDS Study (VLAS).

	VP n (%)	VLAS n (%)	P-value
Cocaine			
No	164 (70)	241 (92)	< 0.001
Yes	70 (30)	22 (8)	
Total	234 (100)	263 (100)	
LSD			
No	183 (79)	254 (97)	< 0.001
Yes	50 (21)	9 (3)	
Total	233 (100)	263 (100)	
Speed (amphetamine)			
No	206 (89)	261 (99)	< 0.001
Yes	25 (11)	2 (1)	
Total	231 (100)	263 (100)	
Heroin			
No	226 (97)	263 (100)	0.010 ^a
Yes	6 (3)	0 (0)	
Total	232 (100)	263 (100)	
Nitrite Inhalants			
No	154 (66)	150 (57)	0.033
Yes	78 (34)	113 (43)	
Total	232 (100)	263 (100)	
Methyldiamphetamine			
No	194 (83)	236 (90)	0.034
Yes	39 (17)	27 (10)	
Total	233 (100)	263 (100)	
Alcohol			
No	17 (7)	30 (11)	0.112
Yes	218 (93)	233 (89)	
Total	235 (100)	263 (100)	
Marijuana/hash			
No	80 (34)	105 (40)	0.175
Yes	155 (66)	158 (60)	
Total	235 (100)	263 (100)	
Tobacco			
No	124 (53)	148 (56)	0.463
Yes	110 (47)	115 (44)	
Total	234 (100)	263 (100)	

^aBased on Fisher's exact test.

CI, 2.1–40.6) for high-risk sexual behavior relative to VP participants after controlling for age, ethnicity, substance use, use of nitrite inhalants, and method of recruitment. None of these variables gave rise to any significant alteration of the estimated effect of cohort membership on high-risk behavior.

Table 5. Logistic regression model for high risk sexual behavior among participants in the Vanguard Project (VP) and the Vancouver Lymphadenopathy-AIDS Study (VLAS).

Variable	Beta	Standard error	Odds ratio	95% CI	P-value
Cohort membership (VLAS versus VP)	2.220	0.757	9.20	2.09–40.61	0.003
Age (per year)	-0.028	0.019	0.97	0.94–1.01	0.140
Ethnicity (Caucasian versus non-Caucasian)	0.597	0.645	1.82	0.51–6.44	0.355
Substance use ^a (yes versus no)	-0.454	0.534	0.64	0.22–1.81	0.395
Nitrite inhalants (yes versus no)	0.306	0.258	1.36	0.82–2.25	0.235
Method of recruitment (physician versus other)	0.056	0.815	1.06	0.21–5.22	0.946

^aSelf-reported use of two or more of the following substances in the previous 12 months: cocaine, LSD, amphetamine, heroin, and methyldiamphetamine. CI, confidence interval.

Incidence of HIV infection

A total of 30 cases of seroconversion were documented in the 48 months following the date of questionnaire completion in the combined cohorts (n = 497) yielding a crude cumulative seroconversion rate of 6%. The product limit estimate of the probability of seroconversion during this follow-up period was 10.7%. A total of 23 of the 30 seroconversions were observed in the VLAS (crude rate = 8.7%) compared with seven seroconversions in the VP (crude rate = 3.0%). At 42 months, the product limit estimate of the cumulative seroconversion rate in the VLAS cohort was significantly higher than the rate observed among VP participants (21.4 versus 3.7%; log-rank *P*-value < 0.001).

Multivariate analysis: time to HIV-1 seroconversion

We used Cox regression to assess the independent effect of cohort membership on time to seroconversion while controlling for demographic variables, sexual behaviors, and substance use. This was accomplished by fitting a series of bivariate Cox models in which we included cohort membership as an independent variable in combination with each of the following covariates: age, ethnicity, number of regular and casual sexual partners, frequency of receptive and insertive anal intercourse with regular and casual partners, substance use, and use of nitrite inhalants. The unadjusted estimate of the seroconversion risk ratio for VLAS participants relative to VP participants was 4.2 (95% CI, 1.8–9.9). As seen in Table 6, after adjustment for each of the aforementioned covariates, the seroconversion risk ratio for VLAS participants relative to VP participants remained significantly elevated in all of these bivariate models.

Discussion

This comparison of two independent cohorts of initially HIV-negative MSM at two distinct time points in the HIV epidemic identified significant differences with

Table 6. Cox regression models for risk of seroconversion among participants in the Vanguard Project (VP) and the Vancouver Lymphadenopathy-AIDS Study (VLAS).

	Beta	Standard error	Risk ratio	95% CI	P-value
Model no. 1					
Cohort membership (VLAS vs. VP)	1.684	0.493	5.39	2.05–14.16	< 0.001
Age (per year)	−0.029	0.027	0.97	0.92–1.02	0.281
Model no. 2					
Cohort membership (VLAS versus VP)	1.293	0.450	3.64	1.51–8.79	0.004
Ethnicity (Caucasian versus non-Caucasian)	0.944	1.047	2.57	0.33–20.03	0.368
Model no. 3					
Cohort membership (VLAS versus VP)	1.833	0.499	6.26	2.35–16.63	< 0.001
Substance use ^a	1.331	0.566	3.79	1.26–11.38	0.018
Model no. 4					
Cohort membership (VLAS versus VP)	1.356	0.440	3.88	1.64–9.19	0.002
Nitrite inhalants (yes versus no)	0.623	0.369	1.86	0.90–3.84	0.091
Model no. 5					
Cohort membership (VLAS versus VP)	1.571	0.455	4.81	1.97–11.73	< 0.001
Number of regular sexual partners ^b	0.319	0.271	1.38	0.81–2.34	0.240
Model no. 6					
Cohort membership (VLAS versus VP)	1.415	0.437	4.12	1.75–9.69	0.001
Number of casual sexual partners ^c	0.438	0.247	1.55	0.96–2.51	0.076
Model no. 7					
Cohort membership (VLAS versus VP)	1.889	0.530	6.61	2.34–18.69	< 0.001
Frequency of receptive anal intercourse with casual sexual partners ^d	0.397	0.213	1.49	0.98–2.26	0.062
Model no. 8					
Cohort membership (VLAS versus VP)	1.767	0.517	5.85	2.13–16.11	< 0.001
Frequency of insertive anal intercourse with casual sexual partners ^d	0.354	0.200	1.43	0.96–2.11	0.077

^aSelf-reported use of two or more of the following substances in the previous 12 months: cocaine, LSD, amphetamine, heroin, and methylamphetamine. ^bOrdinal variable: none, one, two or more regular sexual partners. ^cOrdinal variable: none, one to four, five or more casual sexual partners. ^dRestricted to participants who reported one or more casual sexual partners during previous 12 months (n = 366); ordinal variable – none, up to 30% of the time, 30 to 70% of the time, over 70% of the time. CI, confidence interval.

respect socio-demographic variables, sexual behaviors, condom use, levels of substance use, and rates of seroconversion.

We found that VP participants were younger, less likely to be Caucasian, and were less likely to have attended university or college than participants in the VLAS cohort. The lower mean age of VP participants was not surprising because VP restricted enrollment to men between the ages of 18 to 30 years, whereas VLAS enrollment criteria included a much broader age range. The other socio-demographic differences may be related to the recruitment strategies of the two studies. The earlier VLAS cohort recruited men through general practices in central Vancouver. Conversely, the majority of VP participants were recruited through outreach services and media campaigns and to a lesser extent through clinics, and general practitioners. This broader range of recruitment sites for the VP may help to explain the ethnic and cultural diversity of VP participants in comparison with VLAS participants.

The two cohorts also differed with respect to many risk behaviors related directly to HIV transmission. In comparison with their VLAS counterparts, VP participants reported a higher mean number of regular and casual male sexual partners in the previous year. Men participating in the VP were more likely to report engaging in receptive and insertive anal sex with regular partners. Similar results were detected for receptive anal intercourse with casual partners. However, a higher proportion of VLAS participants reported never using condoms during receptive and insertive anal sex with both regular and casual partners than VP participants. Similar results were found by Kippax *et al.* in a study of two cohorts of Australian MSM recruited 10 years apart which noted increased condom use for receptive and insertive anal intercourse [15].

Even though significantly higher use of nitrite inhalants was observed among VLAS participants, 34% of VP participants reported using poppers, a finding consistent with other studies of gay men [16]. The higher

reported use of nitrite inhalants and unprotected anal sex with regular and casual partners by VLAS participants is consistent with the findings of de Wit *et al.* [6]. This study examined relapse to HIV risk behavior among homosexual men enrolled in a longitudinal cohort study in Amsterdam. Likewise, others have found that the use of nitrite inhalants is a predictor of unprotected anal intercourse [16–19]. It has been suggested that substances facilitate a cognitive disengagement, [20,21] which along with other conditions may cause gay men to abandon their original plan for safety. Myers *et al.* have shown that the likelihood of substance use increases as the number of sexual partners increases [22]. In our analysis, VP participants were found to be more likely to report use of numerous drugs when compared with men in VLAS. Higher proportions of VP participants reported using cocaine, LSD, amphetamine, MDA, and heroin. These differences might be attributed to increased availability and variety of these drugs during the 1990s. Many of these psychoactive drugs are used by gay men to enhance sexual activity. However, our study did not examine the use of these substances during sexual activity. VLAS and VP participants reported similar rates of use of alcohol, tobacco, and marijuana/hashish.

The results of this comparative analysis also indicated that VLAS participants were almost 10 times more likely to report high-risk sexual behavior compared with VP participants after controlling for differences in demographics, levels of drug use, and the method of recruitment between cohort members. This finding was consistent with the results of Johnston *et al.* who recently reported that in Amsterdam, young gay men today are engaging in substantially less high-risk behavior than their counterparts did in 1984–1985 [23].

One of the most striking differences between these cohorts relates to the rates of HIV-1 seroconversion. VLAS participants were approximately five times more likely to seroconvert during the 42-month period of follow-up compared to VP participants. Furthermore, the elevated risk of seroconversion among VLAS participants persisted after adjustment for differences in demographics, substance use, and sexual behavior variables between cohorts. The striking difference in cumulative HIV-incidence between VLAS and VP participants might partially be explained by the higher prevalence of HIV-1 in the gay community in Vancouver during the mid-1980s compared to the mid-1990s. However, our results also indicate that VP participants were far less likely to practice unprotected anal intercourse with both casual and regular sexual partners. Consequently, VP participants were far less likely to seroconvert during follow-up.

There are issues of a temporal nature that could not be examined in this comparative analysis. These include

issues related to advances in the treatment of HIV disease. Specifically, the decision to engage in high-risk sexual behavior may be affected by the recent advances in the treatment of HIV. This may potentially create a new health concern in the community as many young gay men may be less concerned about becoming HIV positive or may be willing to take the chance of getting infected because of these advances [24].

Caution may be required in interpreting our results due to differences in eligibility criteria and recruitment strategies between these two cohort studies. As previously mentioned, the VP recruited younger men and the majority of these participants were recruited through media outreach. However, in the comparative analysis in which we restricted VLAS participants to those between the ages of 18 and 30 years, similar results were observed with respect to differences in sexual behaviors, condom use, and substance use between the cohorts. In addition, multivariate analysis showed that the method of recruitment did not exert an independent effect on high-risk sexual behavior

Our study findings indicate that young gay men in Vancouver have higher numbers of both regular and casual sexual partners, are more likely to participate in anal intercourse with these partners, and more likely to use psychoactive drugs than their counterparts did 10 years ago. These men also report a significantly higher rate of condom use during high-risk sexual practices. Clearly, our results suggest that in recent years in Vancouver higher rates of condom use among young gay men during high-risk sexual practices has resulted in lower rates of HIV-infection compared with their counterparts 10 years ago. Indirectly, this study indicates that prevention activities, at least in this city, probably has had a beneficial effect of reducing the rate of HIV transmission in this population.

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References

1. Health Canada. *AIDS in Canada*. Quarterly Surveillance Update. Ottawa, Ontario: Division of HIV/AIDS Surveillance Bureau of HIV/AIDS and STD Laboratory Centre for Disease Control Health Protection Branch, Health Canada. May 1997.
2. Canadian AIDS Society. *Safer Sex Guidelines*. Ottawa, Ontario: Canadian AIDS Society.
3. Hospers HJ, Kok G. **Determinants of safe and risk-taking sexual**

- behavior among gay men: a review. [Review]. *AIDS Education and Prevention* 1995, 7:74–96.
4. Schechter MT, Jeffries E, Constance P, Douglas B, Fay S, Maynard M. **Changes in sexual behavior and fear of AIDS [Letter].** *Lancet* 1984, i:1293.
 5. Schechter MT, Craib KJP, Willoughby B, *et al.* **Patterns of sexual behavior and condom use in a cohort of homosexual men.** *Am J Public Health* 1998, 78:1535–1538.
 6. de Wit JB, van Griensven GJ. **Time from safer to unsafe sexual behavior among homosexual men.** *AIDS* 1994, 8:123–126.
 7. Stall R, Ekstrand M, Pllack L, McKusick L, Coates TJ. **Relapse from safer sex: the next challenge for AIDS prevention efforts.** *J Acquir Immune Defic Syndr* 1990, 3:1181–1187.
 8. de Wit JB. **The epidemic of HIV among young homosexual men. [Review].** *AIDS* 1996, 10:S21–S25.
 9. de Wit JB. **The epidemic of HIV among young gay men.** *XI International Conference on AIDS*, Vancouver, July 1996 [abstract Mo 03].
 10. Greenland S, Lieb L, Simon P, Ford W, Kerndt P. **Evidence for recent growth of the HIV epidemic among African-American men.** *J Acquir Immune Defic Syndr Hum Retrovirol* 1996, 11:401–409.
 11. Stall R, Barrett D, Bye L, *et al.* **A comparison of younger and older gay men's HIV risk-taking behaviors: the communication technologies 1989 cross-sectional survey.** *J Acquir Immune Defic Syndr* 1992, 5:682–687.
 12. Mansergh G, Marks G. **Age and risk of HIV infection in men who have sex with men.** *AIDS* 1998, 12:1119–1128.
 13. Boyko WJ, Schechter MT, Jeffries E, Douglas B, Maynard M, O'Shaughnessy MV. **The Vancouver Lymphadenopathy-AIDS Study: 3. Relation of HTLV-III sero-positivity, immune status and lymphadenopathy.** *Can Med Assoc J* 1985, 133:28–32.
 14. Schechter MT, Boyko WJ, Douglas B, *et al.* **The Vancouver Lymphadenopathy-AIDS Study: 6. HIV seroconversion in a cohort of homosexual men.** *Can Med Assoc J* 1986, 135:1355–1360.
 15. Kippax S, Song A, Knox S, Crawford J, Van de Ven P, Prestage G. **Changes in anal sex practices among Australian gay men 1986–1997: a rational response to HIV? XII International Conference on AIDS, Geneva, June 1998 [abstract 23416].**
 16. Kingsley LA, Zhou SY, Bacellar H, *et al.* **Temporal trends in human immunodeficiency virus type-1 seroconversion 1984–1989. A report from the Multicentre AIDS Cohort Study (MACS).** *Am J Epidemiol* 1991, 134:331–339.
 17. Myers T, Godin G, Lambert J, Calzavara L, Locker D. **Sexual risk and HIV-testing behavior by gay and bisexual men in Canada.** *AIDS Care* 1996, 8:297–309.
 18. Strathee SA, Hogg RS, Martindale SL, *et al.* **Determinants of sexual risk-taking among young HIV-negative gay and bisexual men.** *J Acquir Immune Defic Syndr Hum Retrovirol* 1998, 19:61–66.
 19. Hogg RS, Craib KJP, Willoughby B, Sestak P, Montaner JSG. **Socio-demographic correlates for risk-taking behavior among HIV seronegative homosexual men.** *Can J Public Health* 1993, 84:423–426.
 20. McKirnan DJ, Ostrow DG, Hope B. **Sex, drugs and escape: a psychological model of HIV-risk sexual behaviors. [Review].** *AIDS Care* 1996, 8:655–669.
 21. Ostrow D, McKirnan D. **Prevention of substance-related high-risk sexual behavior among gay men: critical review of the literature and proposed harm reduction approach. [Review].** *J Gay Lesbian Med Assoc* 1997, 1:97–110.
 22. Hays RB, Paul J, Ekstrand M, Kegeles SM, Stall R, Coates TJ. **Actual versus perceived HIV status, sexual behaviors and predictors of unprotected sex among young gay and bisexual men who identify as HIV-negative, HIV-positive and untested.** *AIDS* 1997, 11:1495–1502.
 23. Johnston S, de Wit JB, Janssen M, Coutinho RA, van Griensven GJP. **Do today's young homosexual men practice safer sex than today's older homosexual men did when they were young? An analysis of sexual behavior change across cohorts in Amsterdam.** *AIDS Behav* 1999, 3:75–81.
 24. Dilley JW, Woods WJ, McFarland W. **Are advances in treatment changing views about high-risk sex? [Letter].** *New Engl J Med* 1997, 337:501–502.