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HTLV-2 infection in injection drug users in King County, Washington

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Abstract

Human T-cell lymphotropic virus type 2 (HTLV-2) is endemic in injection drug users (IDU), and native American populations in the Americas. Transmission is associated with high-risk injection and sexual practices. A cohort of 2561 IDU in King County, Washington completed 2 study visits over 1 y. HTLV-2 infection was detected in 190 (7.4%) of 2561 IDU, and 13 (7.8 cases per 1000 person-y) incident infections occurred during the study. Prevalent infection was associated with female gender, non-white race, longer duration as IDU, having a tattoo, combined injection of heroin and cocaine, and with serologic evidence of hepatitis B and C infection. Seroconversion was more common in women, and was associated with African American race, heterosexual identity and longer duration as IDU. In conclusion, increased risk of HTLV-2 infection was associated with non-white race, and injection drug of choice, suggesting injection networks may play an important role in transmission of HTLV-2. The high correlation of HTLV-2 infection with HCV infection suggests the major route of transmission in IDU is via injection practices. Additional studies are needed to examine the clinical manifestations of HTLV-2 infection, as well as the clinical and virological manifestations of HTLV-2/HCV coinfection.

Introduction

Human T-cell lymphotropic virus type 2 (HTLV-2), like other retroviruses, can be transmitted intravenously, sexually, or from mother to child. HTLV-2 seroprevalence rates in North American injection drug users (IDU) vary between 8.8% and 17.6% with higher rates associated with older age, female gender, non-white race, and heroin injection [1–5]. In a prior study of IDU in Seattle, HTLV-2 infection was more common in people injecting heroin than in people injecting other drugs, in people with antibody to herpes simplex virus type 2 (HSV-2) and in people reporting prior sexually transmitted infection (STI) [4].

Needle sharing is hypothesized to be one of the major routes of HTLV-2 transmission in IDU in the United States and Europe [6,7]. Higher rates of HTLV infection have been associated with injection with a syringe used by another injector (receptive syringe sharing, RSS), ‘backloading’ of injection solution from one syringe to another, and with greater number of lifetime sexual partners, suggesting HTLV-2 transmission is more common in IDU who

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practice high risk injection or sexual practices [1]. In a cohort of HTLV-2 seronegative IDU, incident cases of HTLV-2 were associated with greater number of sexual partners (for women), prior exchange of sex for money, and 'backloading' [8]. In the Guaymi Indians, a population where HTLV-2 is endemic and injection drug use is rare, prevalent HTLV-2 infection rate was 9.5%, with increased risk of infection associated with younger age of first sexual intercourse, greater number of sexual partners and intercourse with a commercial sex worker [9].

HTLV-2 infection is associated with increased rates of certain infections. In a cohort of IDU in the United States, prevalent HTLV-2 infection was associated with increased occurrence of pneumonia, acute bronchitis, urinary tract infection, and myelopathy [10,11]. In addition, HTLV-2 can produce a neurologic syndrome similar to HTLV-1-associated myelopathy/tropical spastic paraparesis (HAM/TSP), with spasticity in the lower limbs, leg weakness, and bladder dysfunction. Unlike HTLV-1 infection, HTLV-2-associated myelopathy commonly also includes peripheral neuropathy and ataxia [12–14]. Neurologic disease in patients with HTLV-2 infection is much less common than in patients infected with HTLV-1 or HIV [10].

Small studies suggest HTLV-2 coinfection alters the natural history of HIV infection. In some studies, patients coinfected with HTLV-2 and HIV had higher baseline CD4+ cell counts and delayed progression to AIDS, while in other studies no effect of HTLV-2 coinfection upon progression of HIV infection was noted [15–18]. Neurologic complications, such as peripheral neuropathy and myelopathy were more common in coinfected IDU than in IDU infected with only HIV [19]. Coinfection with HCV with HTLV-2 or HIV increases HCV RNA viral loads, but the clinical consequences of coinfection have not yet been well defined [20,21].

This analysis was undertaken to examine prevalence, incidence and risk factors for HTLV-2 infection in a cohort of IDU in King County, Washington during the era of syringe-exchange programs; we specifically examined injection and sexual practices, as well as serologic markers of sexually transmitted infections (STI). In addition, we analyzed factors associated with acquisition of HTLV-2 infection.

Subjects and methods

Study design and population

Between June 1994 and January 1997, 2799 IDU were recruited in King County, Washington from 6 drug treatment programs, and social service, corrections and drug-use assessment agencies to participate in the Risk Activity Variables, Epidemiology, and Network Study (RAVEN Study) [22,23]. Subjects were eligible to participate if they had used injection drugs during the previous y, spoke English or Spanish, were 14 y of age or older, and reported they were likely to be in the Seattle-King County area 1 y after enrollment. At the enrollment and 1-y follow-up visits, a standardized questionnaire detailing sociodemographic characteristics, and injection and sexual practices was completed during a face-to-face interview. Blood samples were obtained at each visit. The study protocol was approved by the University of Washington and Washington State institutional review boards and informed, written consent was obtained from each study participant.

Laboratory methods

Blood samples were screened for anti-HTLV-1/2 antibody using ELISA assay (Cambridge Bioscience, Worcester, MA). Samples positive by ELISA received Western blot confirmation (HTLV-1/2 Blot 2.3 or 2.4, Genelabs Diagnostics, Singapore). An individual was considered HTLV-1 seropositive if the ELISA was positive and confirmatory Western blot revealed bands representing gag (p24, p19), gp46, and 2 env proteins (GD21 and rgp 46-I). Individuals with p24, GD21 and rgp46-II bands were considered HTLV-2 seropositive. If gag and env proteins

were absent but other HTLV specific bands present, the individual was considered indeterminate. Subjects with indeterminate results were excluded from the analysis. Screening for HIV-1 infection was performed with ELISA (HIVAB HIV-1 EIA, Abbott Laboratories), and positive specimens were confirmed by Western Blot (Novapath HIV-1 Immunoblot, Biorad).

In addition, blood was tested by enzyme immunoassay for anti-hepatitis C antibody (Abbott HCV EIA 2.0, Abbott Laboratories, Chicago, Illinois) and hepatitis B core antibody (Corzyme, Abbott Laboratories, Chicago, Illinois), for syphilis using MHA-TP followed by RPR and quantitative VDRL in positive specimens, and for HSV infection using an assay developed and performed at the Center for Disease Control using immunoblot with partially purified preparations of baculovirus-expressed full-length gG-1 and gG-2 as target antigens. This test has been assessed in parallel with most other gG-based formats, including the Chiron RIBA, Biokit ELISA, and Western blot and found to be both sensitive and specific [24].

Statistical analyses

Prevalence—Sociodemographic characteristics, injection and sexual risk behaviors, as well as serologic evidence of other viral and sexually transmitted infections were examined as correlates of HTLV-2 prevalence. Univariate analyses included χ^2 and Fisher's exact tests for categorical variables, and *t*-test and Wilcoxon tests for continuous variables. All predictors significant at alpha = 20% in the univariate analyses were included in a multivariate logistic regression model to identify factors independently associated with prevalent HTLV-2 infection. Predictors significant at alpha = 5% were retained in the multivariate model. All tests were 2-sided.

Incidence—Subjects negative for HTLV-2 at baseline were followed to observe incident HTLV-2 infection at 12 months. Potential correlates of prevalent HTLV-2 infection noted above were examined in the analyses of incident HTLV-2 infection. Due to small numbers of seroconvertors, multivariate analyses were not performed. Analyses were performed with SAS (v 9.1, SAS Institute Inc., Cary, NC, U.S.A.) and SPSS for Windows (v 11.5, SPSS Inc., Chicago, IL, U.S.A.).

Results

Of 2799 IDU enrolled in the study, HTLV testing was performed on 2618 (93.5%) of subjects. HTLV-2 infection was confirmed in 189 (7.2%), HTLV-1 infection in 7 (0.3%), and both HTLV-2 and HTLV-1 in 1 (0.04%). In addition, 29 (1.1%) subjects were indeterminate by ELISA and 28 (1.1%) were ELISA-positive but could not be typed by Western blot assay. Over the course of the study, 13 incident cases of HTLV-2 infection were detected in 1574 seronegative subjects who provided serial blood samples, for an incidence rate of 7.8 cases per 1000 person-y. An additional 20 subjects developed 'indeterminate' HTLV serology and 4 developed 'positive' serology but could not be further typed. Unfortunately, no sera remained for additional testing to confirm HTLV-1 or -2 infection. All subjects with known HTLV-2 status (2561 seronegative and seropositive subjects) were included in further analyses.

In univariate analyses, prevalent cases of HTLV-2 infection were associated with female gender (9.4% in females and 6.3% in males), non-white race, prior incarceration, not having a tattoo, and self-identification as heterosexual (7.8% in heterosexuals vs 3.7% in homosexuals or bisexuals) (Table I). HTLV-2 infection was most common in African Americans (22.0%), less common in Latinos and native Americans (4.7%) and least common in whites (3.0%). Mean age was 39.7 y for seropositive women and 45.5 for seropositive men. Prevalent HTLV-2 infection was highly associated with duration of injection, with a prevalence of 1.1% in those injecting 0–5 y, 3.3% in those injecting 6–10 y, and 10.9% in those injecting > 10 y (Table II).

HTLV-2 infection was also associated with type of drug injected in the past 6 months, with highest infection rates (8.9%) in those using speedballs (heroin and cocaine together), vs in subjects using heroin (7.3%) or cocaine (6.0%) separately, and lowest in those using only amphetamines (2.1%) or amphetamines with heroin (1.0%) (Table II). In univariate analyses, receptive needle sharing in the past 6 months was associated with a lower prevalence of HTLV-2 seropositivity. No other specific aspect of the injection process, i.e. sharing of cotton, water, cooker, or backloading, was significantly associated with increased risk of HTLV-2 infection. Of those African American and Caucasian injectors who shared needles, men and women were more likely to share with injectors of the same race (p <.001).

Greater number of reported sexual partners in the last 6 months was not associated with higher risk of HTLV-2 infection (Table II). Participation in anal sex was inversely associated with HTLV-2 infection in both males and females. Self-reported condom use was not associated with lower risk of HTLV-2 infection. Serologic evidence of prior infection with syphilis, HSV-2, hepatitis B and hepatitis C were all associated with higher prevalence of infection. HIV-1 coinfection was detected in 5 (2.6%) individuals, but was not associated with higher HTLV-2 prevalence (Table III).

In multivariate analyses, prevalent HTLV-2 infection was associated with being female (odds ratio (OD) 3.17, 95% Confidence interval (CI) 2.15–4.67; p <0.001), African American race (OR 8.80, 95% CI 5.8–13.37; p < 0.001), longer duration as IDU (OR 3.7, 95% CI 2.49–5.51; p < 0.001), having a tattoo (OR 1.54, 95% CI 1.06–2.23; p = 0.025), and injecting speedballs (OR 1.79, 95% CI 1.16–2.75; p = 0.01) (Table IV). HTLV-2 infection was inversely associated with injecting either cocaine or amphetamines. Although ulcerative STI (HSV-2 or syphilis) were more common in IDU with HTLV-2 infection than in those without HTLV-2 infection (72% vs 53%, p < 0.001), neither was significantly associated with HTLV-2 infection after adjustment for other factors. Needle sharing, prior incarceration and participation in anal sex did not significantly alter risk for HTLV-2 infection after adjustment for race and duration of IDU. Hepatitis B and C were both significantly associated with HTLV-2 infection after adjustment. Indeed, hepatitis C was detected in all but one HTLV-2-infected individual.

Of the 1550 subjects who had serologic testing completed on serial blood samples, 13 (0.8%) individuals had incident HTLV-2 infection detected over 1666.0 person-y (incidence rate 7.8 cases per 1000 person-y). The highest seroconversion rates were in African American females (5 of 94 (5.3%) converted), followed by native American males (1 of 40 (2.5%) converted), then African American males (4 of 191 (2.1%) converted). Of the 4 African American females who responded to questions regarding receptive syringe sharing, only 1 reported sharing in the past y; of the 2 who responded to sexual partner questions, 1 reported having sex with an African American male in the past y, the other reported having sex with African American and Asian American males. Seroconversion was associated with African American race and longer duration as IDU. Although seroconversion was more common in women than men, the difference was not statistically significant (Table V). All 13 seroconvertors self-identified as heterosexual. There was no difference in reported sharing of injection equipment (needles, cookers, cotton strainers or water) between seroconvertors and non-seroconvertors; 9 of 13 (69%) seroconvertors reported sharing injection equipment in the 6 months prior to the study visit when HTLV-2 was detected, with 6 of the 9 reporting receptive syringe sharing, while 1081 of 1444 (75%) non-seroconvertors also reported sharing injection equipment. Of the 4 seroconvertors who denied sharing injection equipment in the past 6 months, 2 reported sharing injection equipment on the baseline questionnaire. Seven of 11 (64%) seroconvertors had serologic evidence of HSV-2 prior to seroconversion. Although the prevalence of ulcerative STDs at baseline was higher in seroconvertors than non-seroconvertors (73% vs 54%), this difference was not statistically significant (p = 0.211). Higher number of reported sexual partners was not significantly associated with seroconversion. However, 1 male seroconvertor

who denied sharing of syringe or other injection equipment at both baseline and follow-up reported 12 female sex partners in the past 6 months; he was also seronegative for both HBV and HCV.

Discussion

HTLV-2 infection remains endemic in IDU in King County, Washington. A prior study of IDU conducted between 1988 and 1990 detected HTLV-2 infection in 10.2%. We detected HTLV-2 infection in 190 (7.4%) of 2618 IDU and 13 incident cases were detected (incidence rate of 7.8 cases per 1000 person-y). This study confirms previously noted associations between HTLV-2 infection and injection practices (e.g. HCV infection), and also suggests new associations. As in previous studies, prevalent cases of HTLV-2 infection in this study were associated with female gender, African American race, longer duration of injection drug use, presence of tattoo, and positive hepatitis B serology. Positive serology for syphilis and HSV-2 were only associated in univariate analysis. This study also detected a significant association of HTLV-2 infection with HCV infection and primary injection drug, with higher prevalence among those who inject heroin together with cocaine and lower prevalence among those who inject amphetamine or cocaine. Both HTLV-2 and HCV infection were strongly associated with duration of IDU.

As in other studies, female gender was associated with prevalent HTLV-2 infection. In prior studies of sexual transmission of HTLV-1, male-to-female transmission was more common than female-to-male transmission, implying that HTLV-1-infected CD8+ lymphocytes in semen may transmit infection more efficiently than infected female genital tract cells [25]. A recent study of HTLV transmission in non-IDU detected 2 HTLV-2 seroconvertors, 1 male-to-female, the other female-to-male. Of note, both seropositive partners of the seroconvertors reported a history of prior STI and rarely to never used condoms [26]. Another plausible explanation for increased rates of HTLV-2 in females is that younger females are more likely to have sexual relationships and/or share injection equipment with older male IDU, a group with higher rates of HTLV-2 infection. In a recent study examining sexual and injection risk behaviors, females were significantly more likely than males to report older male sex partners, as well as injection with or borrowing needles from male sex partners [27]. In our study, women were more likely to share needles (women: 54%, men: 46%, $p < .001$); of those reporting sharing needles, women were also more likely to have sex with their needle-sharing partners (women: 77%, men: 51%, $p < .001$). In addition, African American and Caucasian subjects were more likely to share needles with injectors of the same race ($p < .001$), increasing the likelihood of high HTLV-2 infection persisting within racial groups with higher HTLV-2 prevalences. Studies of non-IDU in Guinea-Bissau detected higher rates of dual HIV-2 and HTLV-1 infection in women than in men, and found HTLV-1 seropositivity was significantly associated with having an HTLV-1-infected spouse, living in a central as opposed to rural area, and HIV-2 seropositivity [28,29]. The authors suggested there may be unmeasured behavioral or biologic factors that were responsible for higher prevalence of dual retroviral infection in women. Thus, several mechanisms may contribute to higher likelihood of HTLV-2 infection among females.

In a prior study, transferring drugs from one syringe to another (backloading) was associated with seroconversion [8]. Our analyses did not detect specific injection practices associated with prevalent or incident infection. Interestingly, sharing needles was not significantly associated with HTLV-2 infection after adjustment for other factors, probably because the group with the highest prevalence of infection, African Americans, also reported the lowest rate of injection equipment sharing. In addition, drug preference (Speedball) was also highly associated with HTLV-2 infection and was the most commonly reported drug injected by African Americans. Consistent with other studies reporting clustering of HTLV-2 infection, the lower prevalence of HTLV-2 infection in subjects reporting needle sharing may reflect lack of social mixing

between sub-populations of IDU with and without endemic HTLV-2 infection living in the same geographic area [30]. Needle-sharing was more common in IDU who were younger (54% of IDU 15–34 y of age vs 46% of IDU 35 y of age or older, $p < 0.001$) and of non-African-American race (37% African American vs 52% other, $p < 0.001$). The strong associations noted above, as well as the association of HTLV-2 with longer duration of injection and with HCV infection – which is primarily transmitted via injection – both suggest that HTLV-2 infection is transmitted via unsafe injection practices, and most often occurs within IDU subgroups defined by race and drug of choice.

A recent study of Spanish IDU noted that prior incarceration was associated with HTLV-2 infection in univariate analysis but not after adjustment for HIV coinfection or having injected in the previous 30 d [6]. Our analysis also found HTLV-2 infection was associated with having been incarcerated, but only in the univariate analysis. After adjustment for race and duration of injection, prior incarceration was no longer significant. In our study, incarceration was associated with higher rates of hepatitis C infection, suggesting incarceration may be a surrogate marker for risky behavior, such as needle sharing, unprotected sex, or other unmeasured factors that are associated with higher transmission rates of retroviral and other sexually transmitted infections. Alternatively, as suggested in a prior Spanish study, prisons may serve as ‘shooting galleries’ with sharing of needles and higher rates of parenteral transmission of infectious agents [31].

13 incident HTLV-2 infections were detected over the course of this study. One seroconvertor who denied sharing injection paraphernalia reported multiple sex partners and had HSV-2 infection, favoring sexual acquisition of HTLV-2 infection. Prevalent and incident cases of HTLV-2 infection were both associated with longer duration of IDU and non-white race, with highest incidence in African American females (5 of 94; 5.3%), followed by native American males (1 of 40; 2.5%), then African American males (4 of 191; 2.1%). Although STI were not associated with incident cases of HTLV-2 infection, the lack of association may be due to the small number of seroconvertors detected during the study. As injection partners in this study were often also sexual partners, particularly for women IDU, our ability to examine the association of HTLV-2 infection with specific injection or sexual practices was limited. However, given the associations noted above, transmission via injection appears to be much more efficient than sexual transmission, although high risk sexual behavior may also contribute to increased risk for acquisition of HTLV-2 infection. Sexual transmission may also be affected by factors we did not measure, including: condom use frequency, age of sexual debut, number of sex partners, and ulcerative STI. HTLV-2 transmission is probably highest when individuals participate in both high risk sexual and injection practices. In addition, there may be an interaction between these 2 behaviors that we were unable to detect in our study due to low number of seroconvertors. Our detection of high rates of HTLV-2 infection in Peruvian MSM, a population that does not use injection drugs, also supports sexual transmission of HTLV-2 [32].

Limitations of this study include the small number of seroconvertors, which prevented us from defining the risk factors associated with acquisition of HTLV-2 infection. In addition, the objectives of this study did not include measuring clinical data or virologic measures; such information could be gathered in future studies and analyzed to better define the clinical manifestations of HTLV-2 infection as well as HTLV-2/HCV coinfection.

The effects of HTLV-2 coinfection upon HIV, hepatitis C or B infection are not well defined. Given the deleterious effects of HIV infection upon the clinical and virologic course of HCV infection, it is plausible that HTLV-2 could adversely affect the natural history of HIV, HCV, or HBV infection. Also, because HCV infection is highly prevalent in IDU, it is particularly important to understand the impact of HTLV-2 infection upon HCV infection and vice versa.

Future studies could examine the effect of HTLV-2 coinfection upon the clinical and virologic manifestations of HIV and hepatitis infections, and increase educational and screening programs for IDU at risk for transmitting these infections.

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Table I

Sociodemographic characteristics of HTLV-2 seropositive and seronegative IDU enrolled in the Raven Study, King County 1994–1997.

Characteristic	HTLV-2 Positive	HTLV-2 Negative	*p*-value
Sex			
Male	102 (6.3)	1519 (93.7)	0.004
Female	88 (9.4)	852 (90.6)	
Race			
White	51 (3.0)	1662 (97.0)	<0.001
Black	117 (22.0)	416 (78.0)	
Latino	5 (4.7)	101 (95.3)	
Native American	5 (4.7)	102 (95.3)	
Asian/Mixed/Other	11 (11.0)	89 (89.0)	
Age			
15–34 y	19 (1.8)	1058 (98.2)	<0.001
35–39 y	37 (6.7)	519 (93.3)	
40–44 y	57 (10.3)	498 (89.7)	
45 + y	77 (20.6)	296 (79.4)	
Sexual identity			
Heterosexual	180 (7.8)	2117 (92.2)	0.02
Bisexual/Homosexual	9 (3.7)	236 (96.3)	
Homeless			
No	64 (7.3)	815 (92.7)	0.96
Yes	64 (7.2)	822 (92.8)	
Have tattoo			
No	113 (8.3)	1253 (91.7)	0.09
Yes	77 (6.5)	1109 (93.5)	
Ever been in jail			
No	5 (2.0)	246 (98.0)	0.001
Yes	166 (7.8)	1956 (92.2)	

Note. Data are no. (%) of subjects. Group *p* values based on χ^2 test.

Table II

Injection and sexual practices by HTLV-2 seropositivity in IDU enrolled in the Raven Study, King County 1994–1997.

Characteristic	HTLV-2 Positive	HTLV-2 Negative	*p*-value
Duration of injection drug use (y)			
<11	19 (2.1)	901 (97.9)	<0.001
11+	171 (10.9)	1392 (89.1)	
Drugs injected in past 6 months			
Heroin with cocaine (speedball)			
No	38 (4.0)	916 (96.0)	<0.001
Yes	131 (8.9)	1335 (91.1)	
Heroin only			
No	19 (5.2)	348 (94.8)	0.14
Yes	150 (7.3)	1902 (92.7)	
Cocaine Only			
No	92 (8.1)	1039 (91.9)	0.04
Yes	77 (6.0)	1212 (94.0)	
Heroin with amphetamines			
No	167 (7.5)	2051 (92.5)	<0.001
Yes	2 (1.0)	199 (99.0)	
Amphetamines Only (stimulants)			
No	158 (8.3)	1743 (91.7)	<0.001
Yes	11 (2.1)	508 (97.9)	
Barbiturates (tranquilizers)			
No	165 (7.2)	2142 (92.8)	0.14
Yes	4 (3.5)	109 (96.5)	
Injection equipment sharing behaviors:			
Shared cookers			
No	44 (5.9)	705 (94.1)	0.17
Yes	116 (7.4)	1449 (92.6)	
Shared cotton			
No	62 (7.0)	828 (93.0)	0.93
Yes	98 (6.9)	1328 (93.1)	
Shared water			
No	84 (7.7)	1011 (92.3)	0.20
Yes	77 (6.3)	1145 (93.7)	
Backloaded			
No	68 (6.6)	961 (93.4)	0.61
Yes	93 (7.1)	1208 (92.9)	
Receptive syringe sharing			
No	104 (8.5)	1122 (91.5)	0.003
Yes	63 (5.4)	1108 (94.6)	
Sexual partners (Women)			
Number of male partners (past 6 months)			

Characteristic	HTLV-2 Positive	HTLV-2 Negative	*p*-value
None	19 (14.4)	113 (85.6)	0.08
1	39 (9.5)	371 (90.5)	
2–3	12 (6.9)	163 (93.1)	
4+	10 (6.5)	143 (93.5)	
Number of female partners (past 6 months)			
None	71 (9.8)	655 (90.2)	0.25
1	4 (7.8)	47 (92.2)	
2+	1 (2.3)	42 (97.7)	
Vaginal sex			
No	19 (15.7)	102 (84.3)	0.008
Yes	61 (8.2)	683 (91.8)	
If vaginal sex, used condom			
<Always	51 (7.8)	602 (92.2)	0.29
Always	10 (11.1)	80 (88.9)	
Anal sex			
No	77 (10.2)	681 (89.8)	0.05
Yes	5 (4.4)	108 (95.6)	
If anal sex, used condom			
<Always	3 (3.2)	91 (96.8)	0.45[a]
Always	1 (6.7)	14 (93.3)	
Sexual partners (Men)			
Number of male partners (past 6 months)			
None	74 (5.6)	1243 (94.4)	0.14
1	0 (0.0)	35 (100.0)	
2+	1 (1.6)	61 (98.4)	
Number of female partners (past 6 Months)			
None	20 (5.6)	336 (94.4)	0.98
1	41 (5.9)	649 (94.1)	
2–3	17 (5.4)	300 (94.6)	
4+	10 (6.0)	158 (94.0)	
Vaginal sex			
No	20 (5.4)	354 (94.6)	0.70
Yes	68 (5.9)	1089 (94.1)	
If vaginal sex, used condom			
<Always	60 (6.2)	913 (93.8)	0.36
Always	8 (4.4)	173 (95.6)	
Anal sex			
No	86 (6.3)	1281 (93.7)	0.007
Yes	2 (1.2)	166 (98.8)	
If anal sex, used condom			
<Always	1 (0.8)	118 (99.2)	0.49[a]
Always	1 (2.1)	46 (97.9)	

Characteristic	HTLV-2 Positive	HTLV-2 Negative	*p*-value

[a] Note. Data are no. (%) of subjects. Group p value based on χ^2 test, or Fisher's exact test.

Table III

Sexually transmitted infections by HTLV-2 seropositivity in IDU enrolled in the Raven Study, King County 1994–1997.

Characteristic	HTLV-2 Positive	HTLV-2 Negative	*p*-value
Serology of other infections			
HIV-1			
Negative	184 (97.4)	2315 (97.9)	0.60[a]
Positive	5 (2.6)	50 (2.1)	
Hep B			
Negative	17 (8.9)	1016 (42.9)	<0.001
Positive	173 (91.1)	1353 (57.1)	
Hep C			
Negative	1 (0.5)	480 (20.3)	<0.001
Positive	189 (99.5)	1889 (79.7)	
Syphilis			
Negative	170 (89.5)	2296 (97.0)	<0.001
Positive	20 (10.5)	71 (3.0)	
Herpes type 1			
Negative	58 (34.9)	723 (36.8)	0.63
Positive	108 (65.1)	1242 (63.2)	
Herpes type 2			
Negative	52 (31.3)	953 (48.6)	<0.001
Positive	114 (68.7)	1007 (51.4)	
HTLV-1			
Negative	189 (99.5)	2364 (99.7)	0.46[a]
Positive	1 (0.50)	7 (0.3)	
Herpes type 2 or syphilis			
No	48 (28.2)	938 (47.5)	<0.001
Yes	122 (71.8)	1036 (52.5)	

[a]Note. Data are no. (%) of subjects. Group *p* value based on χ_2 test, or Fisher's exact test.

Table IV

Multivariate analyses of risk factors associated with prevalent HTLV-2 infection in IDU enrolled in the Raven Study, King County 1994–1997.

Characteristic	Crude OR (95% CI)	*p*-value	Adjusted OR (95% CI)	*p*-value
Sex				
Male	reference		reference	
Female	1.54 (1.14, 2.07)	0.005	3.17 (2.15, 4.67)	<0.001
Race				
White	reference		reference	
Black	9.17 (6.49, 12.95)		8.80 (5.80, 13.37)	
Latino	1.61 (0.63, 4.13)		1.44 (0.49, 4.26)	
N. Amer.	1.60 (0.62, 4.09)		1.75 (0.59, 5.17)	
Asian/Mixed/Other	4.03 (2.03, 8.00)	<0.001	4.32 (2.05, 9.11)	<0.001
Duration of injecting (y)				
<21	reference		reference	
21+	5.18 (3.74, 7.16)	<0.001	3.70 (2.49, 5.51)	<0.001
Ever heroin with cocaine (speedball; past 6 months)				
No	reference		reference	
Yes	2.37 (1.63, 3.43)	<0.001	1.79 (1.16, 2.75)	0.01
Ever cocaine alone (past 6 months)				
No	reference		reference	
Yes	0.72 (.52, .98)	0.04	0.65 (0.45, 0.95)	0.03
Ever heroin with amphetamines (past 6 months)				
No	reference		reference	
Yes	0.12 (.03, .50)	0.003	0.16 (0.04, 0.68)	0.01
Have tattoo				
No	reference		reference	
Yes	0.77 (0.57, 1.04)	.088	1.54 (1.06, 2.23)	.025
Hep B				
Negative	reference		reference	
Positive	7.64 (4.61, 12.66)	<0.001	2.58 (1.45, 4.61)	0.001
Hep C				
Negative	reference		reference	
Positive	48.00 (6.71, 343.23)	<0.001	12.76 (1.73, 94.3)	0.01

Note. All variables found significant at alpha = 10% in univariate analyses were included in the multivariate logistic regression model of prevalent HTLV-2 infection. All tests were 2-sided. Group *p*-values are based on Wald tests, for overall group differences.

Table V

Baseline risk factors associated with incident HTLV-2 infection in IDU participating in the Raven Study, King County 1994–1998.

Characteristic	HTLV-2 Positive	HTLV-2 Negative	*p*-value
Sociodemographics			
Sex			
Male	6 (0.6)	979 (99.4)	0.25[a]
Female	7 (1.2)	558 (98.8)	
Race			
White	3 (0.3)	1072 (99.7)	<0.001
Black	9 (3.2)	276 (96.8)	
Latino	0 (0.0)	53 (100.0)	
Native American	1 (1.4)	72 (98.6)	
Asian/Mixed/Other	0 (0.0)	63 (100.0)	
Age			
<30	0 (0.0)	356 (100.0)	0.048
30+	13 (1.1)	1181 (98.9)	
Sexual identity			
Heterosexual	13 (0.9)	1372 (99.1)	0.63[a]
Bisexual/Homosexual	0 (0.0)	154 (100.0)	
Have tattoo			
No	10 (1.1)	877 (98.9)	0.16
Yes	3 (0.5)	653 (99.5)	
Injection and sex practices			
Duration of injecting (y)			
<11	0 (0.0)	579 (100.0)	0.004
11+	13 (1.4)	913 (98.6)	
Receptive syringe sharing (baseline[b])			
No	7 (1.0)	719 (99.9)	0.38
Yes	4 (0.6)	711 (99.4)	
Shared cooker, cotton or water			
No	3 (0.8)	378 (99.2)	1.00[a]
Yes	9 (0.9)	1004 (99.1)	
Heroin with cocaine (speedball; past 6 months)			
No	3 (0.5)	587 (99.5)	0.20
Yes	10 (1.2)	859 (98.8)	
Cocaine only (past 6 months)			
No	4 (0.6)	679 (99.4)	0.24
Yes	9 (1.2)	767 (98.8)	
Heroin with amphetamines (past 6 months)			
No	11 (0.8)	1331 (99.2)	0.28[a]
Yes	2 (1.7)	115 (98.3)	
Serology			

Characteristic	HTLV-2 Positive	HTLV-2 Negative	*p*-value
Hep B			
Negative	4 (0.6)	648 (99.4)	0.41
Positive	9 (1.0)	888 (99.0)	
Hep C			
Negative	1 (0.4)	282 (99.6)	0.48[a]
Positive	12 (0.9)	1255 (99.1)	
Syphilis			
Negative	12 (0.8)	1491 (99.2)	0.32[a]
Positive	1 (2.2)	44 (97.8)	
Herpes type 2			
Negative	3 (0.5)	597 (99.5)	0.35[a]
Positive	7 (1.0)	672 (99.0)	
Herpes type 2 or syphilis			
No	3 (0.5)	590 (99.5)	0.21
Yes	8 (1.1)	689 (98.9)	

[a] Note. Data are no. (%) of subjects. Group *p*-values based on χ^2 or Fisher's exact test.

[b] Baseline indicates subject reported behavior at first clinic visit.