



ORIGINAL ARTICLE

Associated factors with syphilis among human immunodeficiency virus-infected men who have sex with men in Taiwan in the era of combination antiretroviral therapy



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Background/Purpose: Little is known about the factors associated with syphilis among human immunodeficiency virus (HIV)-infected men who have sex with men (MSM) with access to combination antiretroviral therapy (cART) in Taiwan, where MSM has re-emerged as the leading risk group for HIV transmission.

Methods: From March to October 2011, MSM who regularly attended HIV clinics at a university hospital were invited to participate in the study. A structured questionnaire interview was

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conducted to collect information on sociodemographic characteristics, immunologic and virologic status, sexual partners and patterns of sexual behavior, and use of recreational drugs. **Results:** During the study period, 310 HIV-infected MSM with a mean age of 35.5 years were enrolled, of which 82.3% ($n = 255$) were sexually active and 37.4% ($n = 116$) used recreational drugs in the past 6 months. Syphilis was self-reported in 46.5% ($n = 144$) of the participants after HIV infection was diagnosed and 37.5% (112/299) had serologic evidence of syphilis within 1 year before enrollment. Multivariate logistic regression analysis limited to those who were receiving cART showed that higher CD4 counts [adjusted odds ratio (AOR): 1.17; 95% confidence interval (CI): 1.02–1.34], lower educational achievement (AOR: 1.95; 95% CI: 1.05–3.63), serosorting (AOR: 3.32; 95% CI: 1.04–10.63), and use of recreational drugs (AOR: 2.55; 95% CI: 1.26–5.13) were associated with syphilis.

Conclusion: Improved immune status, lower educational achievement, serosorting, and use of recreational drugs were associated with syphilis among HIV-infected MSM who were receiving cART. These findings suggest that strengthening client-specific counseling is needed to reduce risks for syphilis among HIV-infected MSM in Taiwan.

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Introduction

Since 1996, the widespread use of combination antiretroviral therapy (cART) has not only lowered morbidity and mortality from human immunodeficiency virus (HIV) infection,^{1–3} but also improved the quality of life in patients living with HIV infection and acquired immunodeficiency syndrome (AIDS).^{4,5} However, rising rates of sexually transmitted infections (STIs) have been observed among patients living with HIV infection and AIDS who have access to cART.^{6,7} Several STI epidemics have been well documented in the HIV populations, especially in HIV-infected men who have sex with men (MSM).^{8–11} With the availability of cART, HIV-infected MSM who have achieved undetectable plasma HIV RNA load and favorable immunologic reconstitution have concerns with transmitting HIV to sexual contacts alleviated and are more likely to engage in unprotected sex,^{12,13} which may increase the risk for transmission of STIs and HIV.^{14,15} Those increased high-risk sexual behaviors among HIV-infected MSM were having unprotected sex with HIV-infected partners (serosorting), with partners whose HIV serostatus are unknown, or with casual partners.^{13,16–19} Furthermore, use of recreational drugs may further lead to an increase in high-risk sexual behaviors among MSM and HIV-infected MSM.^{20–22}

As of December, 31, 2012, 24,239 people living with HIV and AIDS have been reported to the Centers for Disease Control, Taiwan, and MSM accounting for 80% of newly diagnosed HIV infections have re-emerged as the leading risk group for HIV infection after control of the outbreak of HIV infection among injection drug users between 2003 and 2007.²³ A high prevalence and incidence of STIs has also been reported among HIV-infected patients and HIV-infected MSM in Taiwan,^{24–26} and more than 40% of the HIV-infected Taiwanese patients with syphilis failed to achieve a serologic response despite treatment.²⁷ In the case management program implemented among HIV-infected patients in Taiwan, 10.4% of the MSM developed new-onset syphilis during the 1st year of enrollment, and a

higher CD4 lymphocyte count and use of recreational drugs were found to be associated with incident syphilis in the MSM.²⁶ In the anonymous voluntary counseling and testing for HIV in northern Taiwan,²⁸ the overall prevalence of syphilis was 2.2%, and the incidence rate was estimated as 1.6/100 person-years. MSM, a history of STIs, and HIV infection were statistically significantly associated with syphilis, and use of recreational drugs and engaging in anal sex increased the risk of syphilis. However, little is known with respect to the role that the serostatus of sexual partners and the relationship with sexual partners may play in syphilis in Taiwan. This study aimed to identify factors that were associated with syphilis among HIV-infected MSM in Taiwan, where access to cART and related HIV care is provided free of charge.

Methods

Study population and setting

We conducted a cross-sectional survey at the National Taiwan University Hospital, the largest hospital designated for HIV care in Taiwan, from March 2011 to October 2011. Eligible participants were patients who identified themselves as MSM, were aged 20 years or older, and did not miss two previous clinic appointments that usually occurred every 1–3 months for those who initiated cART and 3–6 months for those who did not initiate cART. We invited eligible patients who were in the waiting area at the outpatient clinics. The average number of patients in each outpatient clinic was 35–50. It took about 15 minutes to complete the questionnaire. HIV-infected patients have free-of-charge access to HIV care, including testing for CD4 lymphocyte count and plasma HIV RNA load and cART, according to the national treatment guidelines for antiretroviral therapy. Laboratory tests for syphilis [rapid plasma reagin (RPR)] and viral hepatitis were recommended to be performed at least once every year and on an as-needed basis as dictated by the clinical presentation.

Questionnaire interview

A self-administered, anonymous questionnaire interview was conducted and a standardized case record form was used to collect information on demographics, receipt of cART, self-reported calendar year of HIV diagnosis, and history of syphilis after HIV diagnosis; sexual behavior in the past 6 months; recreational drug use in the past and in the past 6 months; the latest RPR titer; and immunologic and virologic data that were notified by the treating physicians or case managers. Data on sexual behavior in the past 6 months included information on the type of sexual partners (main and casual), HIV serostatus of sexual partners, the frequency of consistent condom use during sexual contact, the frequency of condom use during anal sex, oral sex, and other sexual contacts with sexual partners, the frequency of condom use with HIV-infected partners. All items of condom use were measured on a 5-point Likert scale (never, rarely, sometimes, often, and always). We evaluated the baseline demographic, clinical, sexual behavior characteristics in the past 6 months and recreational drug use in the past and in the past 6 months to examine the association with syphilis. The study protocol and questionnaire were reviewed and approved by the Research Ethics Committee of the hospital (Registration No. 201103036RC).

Laboratory investigations

Tests for syphilis were performed using the RPR test (Macro-Vue RPR Card Tests; BD, USA) and *Treponema pallidum* hemagglutination assay (FTI-SERODIA-TPPA; Fujirebio Taiwan Inc., Taoyuan, Taiwan). Patients who received a diagnosis of early syphilis (primary, secondary, or early latent syphilis) were encouraged to submit a voided urine specimen for detection of *Chlamydia trachomatis* and *Neisseria gonorrhoeae*, which was performed with the use of a multiplex real-time polymerase chain reaction (PCR) assay on an automated system (m2000; Abbott Molecular Diagnostics, Des Plaines, IL, USA). Results were reported as positive or negative. Serologies for hepatitis B surface antigen (HBsAg), anti-HBs antibody, and immunoglobulin G-hepatitis B core antibody (anti-HBc antibody) were determined using an enzyme immunoassay (Abbott Laboratories, Abbott Park, IL, USA). Antibodies to hepatitis C virus (HCV) were determined using a third-generation enzyme immunoassay (Ax SYM HCV III; Abbott Laboratories, North Chicago, IL, USA). Plasma HIV RNA load was quantified using the COBAS AMPLICOR HIV-1 Monitor test (COBAS AMPLICOR version 1.5; Roche Diagnostics Corporation, Indianapolis, IN, USA) with a lower detection limit of 40 copies/mL, and CD4 count was determined using FACFlow (BD FACSCalibur; Becton Dickinson, San Jose, CA, USA).

Definitions

Chronic hepatitis B infection was defined as persistent presence of HBsAg for 6 months or longer. The cART that was introduced into Taiwan in April 1997 was defined as the combination of at least three antiretroviral agents containing two nucleoside reverse-transcriptase inhibitors (NRTIs) plus protease inhibitors, one non-NRTI or integrase inhibitor; or three NRTIs. Being sexually active was defined as having

any type of sexual contacts with more than one main or casual partner(s) in the past 6 months before study enrollment.

Statistical analysis

Data were analyzed to determine the statistical significance of differences in demographic characteristics, immunologic, and virologic status, receiving cART or not between the participants with syphilis and those without syphilis after HIV diagnosis was made. Categorical variables were compared by Chi-square test, and continuous variables were compared by Student *t* test. In addition, we also analyzed the behavior characteristics of the participants from three dimensions: sexual partner(s), condom use, and recreational drug use. Univariate analysis was performed to assess the relationship between sexual behavior and recreational drug uses and syphilis. Multivariate logistic regression analysis was used to identify factors associated with syphilis including variables with $p < 0.05$ in the univariate analysis, and the effects of age, education, receiving cART or not, CD4 count, and plasma HIV RNA load (\log_{10}) were also forced into the multivariable model. All statistical analyses were performed with SAS, version 9.1.2.

Results

During the 8-month study period, a total of 310 HIV-infected MSM were enrolled and provided valid responses to the questionnaire interview. Only about 10–20% of the patients in each clinic session participated in this study. The demographic, immunologic, and virologic characteristics of the participants are shown in Table 1. The mean age of the participants was 35.5 years (standard deviation: 7.3) and most (80.0%) were receiving cART. Half of the participants (51.0%) had CD4 count ≥ 500 cells/ μ L, and 64.4% (199/309) had plasma HIV RNA load <40 copies/mL. The estimated interval since HIV diagnosis and the interview (mean years \pm standard deviation) in participants with syphilis and without syphilis were 5.7 ± 4.1 and 4.6 ± 3.7 years, respectively.

A diagnosis of syphilis had ever been made in 46.5% of the participants after they received the diagnosis of HIV infection and 37.5% (112/299) had RPR titers ≥ 4 within 1 year before enrollment into this survey. Chronic hepatitis B infection was identified in 17.6% (40/277) of the participants, while the seroprevalence of HCV was 8.7% (26/300). During the study period, the prevalence of *C. trachomatis* and *N. gonorrhoeae* infection was 8.5% ($n = 9$) and 3.8% ($n = 4$), respectively, in the 106 participants (34.2%) who reported ever receiving a diagnosis of early syphilis and submitted urine specimens for PCR assays.

Most participants (82.3%) were sexually active in the preceding 6 months before enrollment; 93 participants (30.0%) reported having both main partner(s) and casual partner(s), 77 (24.8%) had only casual partner(s), 88 (28.4%) had only main partner(s), and 52 (16.8%) reported not having any partners. More than 40% (44.8%) of the participants reported that they did not know the HIV serostatus of their main or casual partner(s), and 26.9% ($n = 83$) reported having some or all main or casual partner(s) who were HIV positive (serosorting).

Table 1 Demographics and clinical characteristics of 310 HIV-infected MSM, including 248 who received cART

	Total	All participants (N = 310)		p	Only participants receiving cART included (N = 248)		p
	N = 310	Syphilis (–) (N = 166, 53.5%)	Syphilis (+) (N = 144, 46.5%)		Syphilis (–) (N = 125, 50.4%)	Syphilis (+) (N = 123, 49.6%)	
Characteristics							
Age (mean ± SD), years	35.45 ± 7.29	35.79 ± 7.64	35.06 ± 6.87	0.38	37.34 ± 7.59	35.24 ± 6.82	0.02
≤35, N (%)	164 (52.9)	84 (51.2)	80 (48.8)	0.38	52 (44.1)	66 (55.9)	0.06
>35	146 (47.1)	82 (56.2)	64 (43.8)		73 (56.2)	57 (43.8)	
Education, N (%)							
Below university	121 (39.2)	57 (47.1)	64 (52.9)	0.08	49 (45.4)	59 (54.6)	0.18
University and above	188 (60.8)	108 (57.4)	80 (42.6)		75 (54.0)	64 (46.0)	
CD4 count, cells/μL							
(mean ± SD)	529.99 ± 225.97	507.28 ± 216.55	556.02 ± 234.37	0.06	518.87 ± 223.24	581.09 ± 234.95	0.03
(median, IQR)	(504, 369–642)						
<500, N (%)	152 (49.0)	91 (59.9)	61 (40.1)	0.03	65 (58.6)	46 (41.4)	0.02
≥500	158 (51.0)	75 (47.5)	83 (52.5)		60 (43.8)	77 (56.2)	
Plasma HIV RNA load log₁₀ copies/mL							
(mean ± SD)	2.32 ± 1.21	2.38 ± 1.23	2.25 ± 1.18	0.34	1.76 ± 0.41	1.87 ± 0.74	0.13
(median, IQR)	(1.60, 1.60–2.61)						
Receipt of cART, N (%)							
No	62 (20.0)	41 (66.1)	21 (33.9)	0.03	—	—	—
Yes	248 (80.0)	125 (50.4)	123 (49.6)		—	—	

cART = combination antiretroviral therapy; HIV = human immunodeficiency virus; IQR = interquartile range; MSM = men who have sex with men; SD = standard deviation.

Table 2 Use of recreational drugs in the past 6 months and the frequency of condom use during sexual activity

	Used (N = 116)	Not used (N = 57)	χ^2 value
	n (%)	n (%)	
<i>Frequency of consistent condom use</i>			31.85*
Sometimes/rarely/never	54 (46.6)	7 (12.3)	
Always/often	58 (50.0)	35 (61.4)	
No sexual activity in the past 6 months	4 (3.4)	15 (26.3)	
<i>Anal sex: the frequency of condom use</i>			30.44*
Sometimes/rarely/never	46 (39.7)	6 (10.5)	
Always/often	65 (56.0)	34 (59.7)	
No anal sex or sexual activity in the past 6 months	5 (4.3)	17 (29.8)	
<i>Oral sex: the frequency of condom use</i>			20.96*
Sometimes/rarely/never	95 (81.9)	32 (56.1)	
Always/often	15 (12.9)	8 (14.0)	
No oral sex or sexual activity in the past 6 months	6 (5.2)	17 (29.8)	
<i>Frequency of condom use with HIV-infected sexual partner</i>			27.84*
Sometimes/rarely/never	43 (37.1)	4 (7.6)	
Always/often	27 (23.3)	12 (22.6)	
Unknown serostatus of sexual partner(s)	41 (35.3)	23 (43.4)	
No sexual activity in the past 6 months	5 (4.3)	14 (26.4)	

"Used group" are those participants who ever used recreational drugs in the past as well as in the past 6 months, whereas "not used group" are those who used recreational drugs only in the past, but not in the past 6 months.

* $p < 0.0001$.

HIV = human immunodeficiency virus.

The frequency of condom use varied with forms of sexual contact. Of the 310 participants who responded to the query on frequency of condom use, 27.7% ($n = 86$) reported that they sometimes/rarely/never used condom consistently during sexual activity, 24.7% (76/308) and 64.7% (200/309) participants sometimes/rarely/never used condom during anal and oral sex, respectively, in the past 6 months. Among the participants who reported a lower frequency of condom use during anal sex, 65.8% (50/76) reported that they sometimes/rarely/never used condom when having anal sex with HIV-positive main or casual partner(s) in the past 6 months; the rate decreased to 30.3% (23/76), when they had anal sex with partner(s) whose HIV serostatus was unknown.

Of the 310 participants, 37.4% (116) admitted to use of recreational drugs in the past and in the past 6 months; and 18.4% (57) reported that they used recreational drugs only in the past, but not in the past 6 months; and 44.2% (137) reported that they never used recreational drugs. Participants who used recreational drugs in the past 6 months were less likely to use a condom during oral sex (95/116) and practice serosorting (43/116). There was a statistically significant association between recreational drug use and the frequency of condom use during all types of sexual contacts (Table 2). Among the 116 participants who reported using recreational drugs in the past and in the past 6 months, 60.3% ($n = 70$) and 55.2% ($n = 64$) used 3,4-methylenedioxy-*N*-methylamphetamine (ecstasy) and ketamine, 48.3% ($n = 56$) used amyl nitrites (poppers, RUSH), and 51.7% ($n = 60$) used sildenafil citrate (Viagra). Up to 44.8% had used a variety of drugs within the past 6 months, including ecstasy, ketamine, poppers, and sildenafil citrate.

The participants with syphilis had higher CD4 counts than those without syphilis (556.0 vs. 507.3 cells/ μ L). When

the analysis was limited to participants who were receiving cART, the participants with syphilis were younger and had higher CD4 counts than those without syphilis (Table 1). In univariate analyses (Table 3), the factors identified to be associated with syphilis included having some (or all) main or casual sexual partner(s) who were also seropositive for HIV; never, rarely, or sometimes used a condom consistently during sexual activity; condom use while having anal sex and oral sex; and use of recreational drugs in the past and in the past 6 months. In the final multivariable model, receipt of cART [adjusted odds ratio (AOR): 7.02; 95% confidence interval (CI): 2.06–23.92], higher CD4 counts (AOR: 1.13; 95% CI: 1.00–1.27), plasma HIV RNA load (AOR: 1.51; 95% CI: 1.00–2.27), and use of recreational drugs in the past as well as in the past 6 months (AOR: 2.04; 95% CI: 1.10–3.79) were associated with syphilis (Table 4).

Because most participants (80%) were receiving cART at enrollment, we repeated multivariate logistic regression analysis by limiting the analyses to those participants who were on cART. The results indicated that educational achievement below university level (AOR: 1.95; 95% CI: 1.05–3.63), higher CD4 counts (AOR: 1.17; 95% CI: 1.02–1.34), some (or all) main or casual partner(s) being HIV positive (AOR: 3.32; 95% CI: 1.04–10.63), and use of recreational drugs in the past and in the past 6 months (AOR: 2.55; 95% CI: 1.26–5.13) were significantly associated with syphilis (Table 4).

Discussion

In this survey conducted among the participants with access to cART who were sexually active MSM, we found that a high proportion of participants had syphilis after they received

Table 3 Results of univariate analysis to identify associated factors with syphilis

Variable	All participants					Only participants receiving cART				
	All (N = 310)	Syphilis (-) (N = 166)	Syphilis (+) (N = 144)	OR (95% CI)	p	All (N = 248)	Syphilis (-) (N = 125)	Syphilis (+) (N = 123)	OR (95% CI)	p
Had main or casual partner(s) in the past 6 months										
Had both main and casual partners	93 (30.0)	45 (48.4)	48 (51.6)	2.02 (0.99, 4.06)	0.0503	75 (30.2)	34 (45.3)	41 (54.7)	2.49 (1.16, 5.36)	0.019
Only had casual partner(s)	77 (24.8)	38 (49.4)	39 (50.6)	1.94 (0.94, 4.00)	0.0736	56 (22.6)	22 (39.3)	34 (60.7)	3.19 (1.41, 7.23)	0.005
Only had main partner(s)	88 (28.4)	49 (55.7)	39 (44.3)	1.50 (0.74, 3.06)	0.2600	71 (28.6)	38 (53.5)	33 (46.5)	1.79 (0.83, 3.89)	0.138
Did not have any partner	52 (16.8)	34 (65.4)	18 (34.6)	Ref		46 (18.6)	31 (67.4)	15 (32.6)	Ref	
HIV status of main or casual sexual partner(s) ^a										
All or some being HIV-infected	83 (26.9)	32 (38.6)	51 (61.4)	3.01 (1.46, 6.20)	0.0028	66 (26.8)	20 (30.3)	46 (69.7)	4.75 (2.12, 10.68)	0.0002
Unknown	138 (44.8)	73 (52.9)	65 (47.1)	1.68 (0.87, 3.26)	0.1237	105 (42.7)	53 (50.5)	52 (49.5)	2.03 (0.98, 4.19)	0.06
All being HIV-uninfected	35 (11.4)	26 (74.3)	9 (25.7)	0.65 (0.25, 1.69)	0.3803	29 (11.8)	20 (69.0)	9 (31.0)	0.93 (0.34, 2.53)	0.89
No partners in the past 6 months	52 (16.9)	34 (65.4)	18 (34.6)	Ref		46 (18.7)	31 (67.4)	15 (32.6)	Ref	
Frequency of consistent condom use										
Sometimes/rarely/never	86 (27.7)	36 (41.9)	50 (58.1)	3.10 (1.52, 6.34)	0.0019	65 (26.2)	22 (33.8)	43 (66.2)	3.91 (1.77, 8.61)	0.0007
Always/often	169 (54.5)	92 (54.4)	77 (45.6)	1.87 (0.98, 3.57)	0.0579	135 (54.4)	71 (52.6)	64 (47.4)	1.80 (0.91, 3.59)	0.09
No sexual activity in the past 6 months	55 (17.7)	38 (69.1)	17 (30.9)	Ref		48 (19.4)	32 (66.7)	16 (33.3)	Ref	
Anal sex: frequency of condom use ^a										
Sometimes/rarely/never	76 (24.7)	34 (44.7)	42 (55.3)	2.59 (1.30, 5.15)	0.0068	60 (24.3)	24 (40.0)	36 (60.0)	3.08 (1.44, 6.62)	0.004
Always/often	167 (54.2)	88 (52.7)	79 (47.3)	1.88 (1.03, 3.43)	0.0398	132 (53.4)	64 (48.5)	68 (51.5)	2.18 (1.13, 4.22)	0.02
No anal sex or sexual activity	65 (21.1)	44 (67.7)	21 (32.3)	Ref		55 (22.3)	37 (67.3)	18 (32.7)	Ref	
Oral sex: frequency of condom use ^a										
Sometimes/rarely/never	200 (64.7)	96 (48.0)	104 (52.0)	2.17 (1.20, 3.92)	0.0106	155 (62.7)	66 (42.6)	89 (57.4)	2.48 (1.31, 4.72)	0.006
Always/often	46 (14.9)	28 (60.9)	18 (39.1)	1.29 (0.58, 2.83)	0.5334	38 (15.4)	24 (63.2)	14 (36.8)	1.08 (0.45, 2.55)	0.871
No oral sex or sexual activity	63 (20.4)	42 (66.7)	21 (33.3)	Ref		54 (21.9)	35 (64.8)	19 (35.2)	Ref	
Recreational drug uses										
In the past and in the past 6 months	116 (37.4)	49 (42.2)	67 (57.8)	2.46 (1.48, 4.08)	0.0005	83 (33.5)	28 (33.7)	55 (66.3)	3.51 (1.07, 4.17)	<.0001
In the past but not in the past 6 months	57 (18.4)	29 (50.9)	28 (49.1)	1.73 (0.93, 3.24)	0.0848	48 (19.3)	22 (45.8)	26 (54.2)	2.11 (1.07, 4.17)	0.03
Never used before	137 (44.2)	88 (64.2)	49 (35.8)	Ref		117 (47.2)	75 (64.1)	42 (35.9)	Ref	

^a Missing data: several participants did not answer the indicated questions.

95% CI = 95% confidence interval; cART = combination antiretroviral therapy; HIV = human immunodeficiency virus; OR = odds ratio.

the diagnosis of HIV infection. In the participants who were receiving cART, higher CD4 counts, lower educational achievement, serosorting, and use of recreational drugs were statistically significantly associated with syphilis.

In this study, we found that having some (or all) HIV-infected partner(s) in the past 6 months, either main or casual partner(s), were associated with syphilis. This finding is consistent with those of previous studies, which demonstrated that HIV-infected MSM engaging in unsafe sex with HIV-infected (serosorting) or serostatus unknown partners(s), either main or casual partner(s), might place themselves at risk for other STIs as well as HIV-uninfected persons at risk for HIV.^{18,21} Serosorting is considered a harm-reduction approach to reduce the risk of HIV transmission among HIV-infected MSM.¹⁸ However, serosorting may facilitate the spread of STIs when sexual partners of the same serostatus have STIs and safe sex using condoms is not practiced consistently. Although most STIs are treatable, concerns may arise with respect to the transmission of antiretroviral-resistant HIV or HIV superinfection among HIV-infected and noninfected people.^{29,30} Other STIs, such as HCV, may also raise concerns in Taiwan because recent acquisition of syphilis was associated with HCV seroconversion and the incidence of recent HCV infections has increased among the HIV-infected MSM.³¹

Use of recreational drugs may increase risk of losing control over safe sex practices during the sexual encounters. In this study, recreational drug use in the past and in the past 6 months was associated with syphilis in the final multivariate analysis. Previous studies have demonstrated that substance uses were associated with STIs and unprotected anal sex.^{11,16,21} Among the clients who sought voluntary counseling and testing and subsequent follow-up for HIV infection in Taiwan, recreational drug use and unprotected anal sex were risk factors for HIV infection and syphilis.²⁸ Higher CD4 counts and recreational drug use were also found to be associated with incident syphilis among the HIV-infected MSM who were enrolled in the case management program.²⁶ It is likely that HIV-infected patients with improved health status with cART have more opportunities to engage in sexual activities, and people who use recreational drugs for sexual activities have more chances to have relapses of unsafe sex.²⁶

Previous studies have shown that unprotected sexual behavior was significantly higher among MSM or HIV-infected MSM who believed that cART reduces the risk of HIV transmission or who were less concerned about HIV due to the availability of cART and advances of HIV treatment. In our study, we also demonstrated that higher CD4 counts were associated with syphilis among HIV-infected MSM who

Table 4 Multiple logistic regression to identify the associated factors with syphilis in all participants and in those who were receiving cART only

Effect	All participants (n = 310)	p	Only participants receiving cART were included (n = 248)	p
	OR (95% CI)		OR (95% CI)	
Receipt of cART	7.02 (2.06, 23.92)	0.002	—	—
Age	1.43 (0.84, 2.42)	0.18	1.54 (0.84, 2.84)	0.17
Education (low level vs. high level)	1.61 (0.94, 2.78)	0.08	1.95 (1.05, 3.63)	0.03
CD4 count (per 100-cell/ μ L increment)	1.13 (1.00, 1.27)	0.047	1.17 (1.02, 1.34)	0.02
Plasma HIV RNA load (log ₁₀ copies/mL)	1.51 (1.00, 2.27)	0.049	1.65 (0.97, 2.78)	0.06
HIV serostatus of main or casual sexual partner(s)				
All or some being HIV-infected	1.82 (0.65, 5.09)	0.25	3.32 (1.04, 10.63)	0.04
Unknown	1.07 (0.41, 2.81)	0.89	1.44 (0.48, 4.33)	0.52
All being HIV-uninfected	0.47 (0.14, 1.58)	0.22	0.74 (0.20, 2.79)	0.66
No main or casual partners in the past 6 months	Ref		Ref	
Frequency of consistent condom uses				
Sometimes/rarely/never	2.17 (0.58, 8.17)	0.25	1.66 (0.38, 7.20)	0.50
Always/often	1.50 (0.41, 5.50)	0.54	0.92 (0.22, 3.87)	0.91
No sexual activity in the past 6 months	Ref		Ref	
Anal sex: frequency of condom use				
Sometimes/rarely/never	1.02 (0.28, 3.64)	0.98	1.19 (0.28, 5.08)	0.82
Always/often	1.22 (0.37, 4.04)	0.74	1.72 (0.44, 6.67)	0.44
No anal sex or sexual activity in the past 6 months	Ref		Ref	
Oral sex: frequency of condom uses				
Sometimes/rarely/never	0.99 (0.33, 3.02)	0.99	0.90 (0.27, 3.06)	0.87
Always/often	0.72 (0.20, 2.54)	0.61	0.50 (0.12, 2.05)	0.34
No oral sex or sexual activity in the past 6 months	Ref		Ref	
Recreational drug uses				
In the past and in the past 6 months	2.04 (1.10, 3.79)	0.02	2.55 (1.26, 5.13)	0.009
In the past but not in the past 6 months	1.72 (0.87, 3.41)	0.12	2.11 (0.99, 4.51)	0.05
Never used before	Ref		Ref	

95% CI = 95% confidence interval; cART = combination antiretroviral therapy; HIV = human immunodeficiency virus; OR = odds ratio.

were receiving cART. It is likely that quality of life for individuals with HIV has improved substantially with cART, which may lead to resumption of sexual activity after achieving stable immune status.

The results of this study are consistent with those of a previous study in France that lower educational attainment was a risk factor for syphilis acquisition among MSM.¹⁵ In Taiwan, MSM and lower educational achievement were associated with increased risk for amebiasis among persons seeking voluntary counseling and testing for HIV infection.³² An association has been demonstrated between treatment optimism-related risk behavior and lower educational attainment among MSM.³³ Another study in Japan also found that a lower educational achievement was associated with substance uses.³⁴ Because of treatment optimism, concerns with safe sex may be alleviated, and people who had lower educational attainment might misunderstand about HIV transmission risk while they were taking cART. Therefore, client-specific counseling is needed to help these patients easily learn the risk-reduction skill.

There are several limitations of this study. First, the participants in this study were MSM who sought medical care regularly, and our findings may not be generalizable to other risk groups or to the patients who did not adhere to clinical care. Second, we used self-administered questionnaire interview to obtain information on sexual behaviors and use of recreational drugs in the past or within the past 6 months. Recall bias, underreporting, or giving a falsified response to meet social expectation may have occurred. Third, the cross-sectional study design precludes us from assessing the sexual relationships that are likely to be dynamic among MSM in Taiwan.

In conclusion, factors that were associated with syphilis among HIV-infected MSM who were receiving cART in Taiwan included lower educational achievement, higher CD4 counts, serosorting, and use of recreational drugs. Our study suggests that more intensive health education and client-specific risk-reduction counseling that target HIV-infected MSM who receive cART are needed in Taiwan.

Conflicts of interest

The authors declare that they have no financial or non-financial conflicts of interest related to the subject matter or materials discussed in the manuscript.

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