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Young Men Who Have Sex with Men at High Risk for HIV, Bangkok MSM Cohort Study, Thailand 2006–2014

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Abstract

High HIV incidence has been reported in young men who have sex with men (YMSM) in North America and Western Europe, but there are limited data from Southeast Asia suggesting MSM may be the driver of the HIV epidemic in this region. We described HIV incidence and risk factors among 494 YMSM enrolled in a cohort study in Bangkok, Thailand. The HIV incidence was 7.4 per 100 person-years. In multivariable analysis, reporting use of an erectile dysfunction drug in combination with club drugs, having receptive or both insertive and receptive anal intercourse with men, having hepatitis A infection, having rectal *Chlamydia trachomatis*, having hepatitis B infection prior to HIV seroconversion, and reporting not always using condoms with male steady partners were significantly associated with HIV incidence in YMSM. Reduction in new HIV infections in YMSM are critical to reach targets set by Thailand and the region.

Keywords

HIV incidence; Men who have sex with men; Thailand; Young population; Adolescent

Disclaimer The findings and conclusions presented in this paper are those of the authors and do not necessarily represent the views of the U.S. Centers for Disease Control and Prevention.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflicts of interests.

Ethical Approval The study protocol was approved by the Ethical Review Committee for Research in Human Subjects of the Thailand Ministry of Public Health, and by the Institutional Review Board of the U.S. Centers for Disease Control and Prevention. We obtained written informed consents from all participants.

Introduction

Young people remain at the center of the HIV epidemic across the world, accounting for 30% of all new global HIV infections [1]. Young men who have sex with men (YMSM) are especially at risk with high incidence being reported in many countries [2–5]. Although the HIV epidemic in young adults is a major burden in several regions, there is a scarcity of incidence studies in YMSM in Thailand and other countries with generalized epidemics where most new infections are occurring in the general population due to sexual transmission [6–8]. In the United States, YMSM are at the highest risk with HIV incidence ranges from 3.4 to 4.1 per 100 person-years (PY) [3, 4]. Some Asian countries, such as Thailand and China, reported HIV incidence ranged from 6.7 to 8.8 per 100 PY [9–11]. Studies of YMSM in the United States and Asia find similar epidemiologic risk factors including prevalent and incident sexually transmitted infections (STIs), and use of recreational drugs [3, 4, 9, 12]. Hepatitis B (HBV) and *Chlamydia trachomatis* (CT) are STIs that spread mainly through sexual contract without a condom and have been shown to increase in risk of HIV acquisition [13, 14]. During the past decades, ongoing outbreaks of hepatitis A (HAV) infection among MSM and transmission through sexual contact are well documented [15–18]. However, information regarding HAV as a risk factor for HIV acquisition in young MSM are limited [19]. Specific venues such as saunas and meeting men through social networks have been recognized as common places and ways MSM meet sexual partners. Studies have demonstrated MSM going to the sauna and seeking sexual partners through the internet were more likely to be younger and engage in high risk sexual behavior [20, 21]. Characteristics of sexual partnership have an impact upon risky behaviors and the majority of unprotected sex events occurring between steady/regular partners, this being associated with HIV seroincidence [22–24]. Anal sex roles also contribute to high risk of HIV seroconversion especially among YMSM who adopt the receptive anal sex role without a condom [5, 25]. Early age at first anal sex has been shown to be associated with HIV acquisition among MSM; studies also demonstrate early age at first anal sex is associated with sexual risk taking [26, 27]. Published literature has shown that the trend of HIV infection has continued to increase, with potential risk factors including age structure, sexual behavior and relationships, STIs, substance use, and virtual and physical venues contributing to the HIV epidemic in YMSM.

HIV surveillance has shown increasing prevalence among Bangkok MSM aged 22 years or younger from 13% in 2003 to 22% in 2007, and 24% in 2014 [28]. Previous analysis of the Bangkok MSM Cohort Study (BMCS) demonstrated that YMSM ages < =21 years have higher HIV incidence than men ages > 21 years [29]. Although recent assessments from BMCS had provided important information about the current epidemic among MSM, epidemiological and behavioral factors associated with HIV acquisition in YMSM have not been fully described. Data regarding HIV infection in YMSM are needed to facilitate the provision of HIV services for this group. In this analysis, we assessed HIV incidence and risk factors for seroconversion among YMSM in the BMCS, Bangkok, Thailand from 2006 to 2014.

Methods

Participants

Methodology of the BMCS has been previously published [10, 29, 30]. In brief, participants were enrolled into an open longitudinal cohort at Silom Community Clinic (SCC) in central Bangkok between April 2006 and January 2008, and September 2009 and November 2010. Thai men, aged ≥ 18 years, residing in the Bangkok metropolitan area, who reported oral or anal sex with another man in the past 6 months, and were available to be followed up every 4 months for 3–5 years, were eligible for enrollment. Participants were recruited using non-probability sampling from venues regularly patronized by MSM (e.g. sauna, bars, and park), websites frequented by MSM (e.g. Silom Community Clinic Website and Facebook, Rainbow Sky Association of Thailand Website), a male sexual health clinic, outreach workers, and word of mouth among participants.

Measures

All participants completed audio computer-assisted self-interview (ACASI) in a private room at SCC. Information about recreational drug and alcohol use (e.g., frequency and type of drugs, drug use to increase sexual pleasure, use of erectile dysfunction drug, and in combination with other drugs, frequency of intoxication from alcohol), and sexual behavior (e.g., number and gender of steady, casual, and commercial partners, condom use, and group sex) were collected at enrollment and at 4 months intervals. Binge drinking was defined from a question asking about how often the participant got drunk from alcohol in the past 4 months which was assessed on a 7-point scale (never, once a month or less, two or three times per month, about once per week, two or three times per week, almost every day, and every day). Any response of drinking two or three times per week, almost every day, and every day was defined as binge drinking [10]. Drug use variables included the use of specific drugs in the past 4 months including, cannabis, ecstasy (MDMA), amphetamine, methamphetamine (ice or crystal), ketamine, sedative, popper, cocaine, and gamma hydroxyl butyrate (GHB), other specify, and erectile dysfunction drugs or Viagra®. Each drug was assessed as a dichotomous measure (yes and no). If the response was ‘yes’, the participants were asked if they ever used that drug when they had sex or to increase sexual pleasure in the past 4 month or used in combination with erectile dysfunction drugs or Viagra®. We defined “club drugs” as using any of the following: cannabis, ecstasy (MDMA), amphetamine, methamphetamine (ice or crystal), ketamine, cocaine, and GHB. A steady partner was defined as a partner with whom the participant had sex and an emotional bond and without being paid; casual partners were partners with whom the participant had sex without an emotional bond and without being paid. Beginning in April 2010, at 4 months intervals, we introduced questions about internet use and attendance at a ‘high party’. We defined a ‘high party’ as two or more men having sex while using drugs, including one or a combination of methamphetamine (meth, crystal, ice), ecstasy (MDMA), or erectile dysfunction drugs.

HIV counseling and testing was performed at enrollment and at each follow-up visit. Examinations for STIs were conducted at enrollment and every 12 months. We performed HIV testing on oral fluid using O raQuick® HIV-1/2 Rapid Test (OraSure Technologies,

Bethlehem, PA, USA). All reactive tests were confirmed with three rapid tests algorithm on blood based on Thai national guidelines for HIV testing: 1) Determine™ HIV-1/2 (Abbott Laboratories, Tokyo, Japan) or Determine™ HIV-1/2 (Alere Medical, Chiba, Japan); 2) DoubleCheck™ II HIV-1 & 2 (Organics, Yavne, Israel), or SD-Bioline HIV-1/2 3.0 (beginning February 2011; Standard Diagnostics, Kyonggi-do, South-Korea), or DBCheck Gold Ultra HIV-1/2 (beginning January 2012; Orgenics, Yavne, Israel); 3) Capillus™ HIV-1/HIV-2 (Trinity Biotech, Jamestown, NY, USA) or Core™ HIV-1/2 (beginning November 2008; Birmingham, UK). Starting in February 2010, YMSM who had a non-reactive HIV test at any visit were evaluated for acute and early HIV infection. Acute and early HIV infection was defined as having non-reactive result by oral fluid anti-HIV rapid test, but detectable HIV-1 RNA by nucleic acid amplification testing (NAAT) (Aptima®HIV-1 RNA Qualitative Assay, GenProbe Inc., San Diego, USA), or by a reactive HIV Ag/Ab result by 4th generation enzyme immunoassay (EIA; AxSym HIV Ag/Ab Combo, Abbott laboratories, Wiesbaden, Germany) or by Architect HIV Ag/Ab Combo, Abbott Laboratories, (beginning May 2012; Wiesbaden, Germany).

We collected and tested rectal swabs for *Neisseria gonorrhoeae* (NG) and *Chlamydia trachomatis* (CT) by PCR (Roche Amplicor®, Roche Diagnostics, Branchburg, NJ, USA). Blood specimens were tested for antibodies to hepatitis A virus (anti-HAV) and hepatitis B core antigen (anti-HBc; Murex, Abbott Diagnostics, Dartford, UK, or Monolisa, Bio-Rad, Marnes-la-Coquette, France), anti-herpes simplex virus type-1 and 2 (anti-HSV-1 and 2; HerpeSelect 1 and 2 ELISA, Focus Diagnostics, Cypress, CA, USA), and antibody to *Treponema pallidum (T. pallidum)* by rapid plasma reagin (RPR) assay (Macro-Vue™ RPR 18 mm Circle Card Test, Becton–Dickinson Microbiology Systems, Sparks, MD, USA). Any reactive RPR titer was confirmed by rapid immunochromatographic diagnostic testing (RDT; Determine™ Syphilis TP, Abbott Laboratories, Tokyo, Japan). Persons with RPR ≥ 1:8 and positive RDT were considered infected with *T. pallidum*.

Data Analysis

Stata/SE 11.2 (StataCorp, College Station, TX) was used for analysis. We investigated HIV infection in YMSM aged 18–24 years at enrollment. We calculated HIV prevalence and exact binomial 95% confidence intervals (CIs). Logistic regression was used to evaluate the association between socio-demographic characteristics at baseline (i.e. age, education, employment, and living situation) and HIV prevalence. Incident HIV infection was defined as either seroconversion from HIV-negative to HIV-positive based on rapid HIV tests, or if no seroconversion, NAAT or fourth generation EIA tests positive. We assumed the time of HIV seroconversion as occurring at the midpoint between the date of the last negative and the first positive HIV test, and if seroconversion did not occur, time was censored at the last HIV test. We calculated total person-time of follow-up using the date of first testing and the date of last testing. The total number of HIV infections detected were divided by the total number of tests and reported with exact Poisson 95% Confidence Intervals (CIs). HIV incidence density was calculated as the number of new infections divided by the number of person-years of follow-up, along with exact Poisson 95% CIs. We estimated the 60 month cumulative HIV incidence using Kaplan–Meier analysis. We analyzed factors associated with HIV incidence using Cox proportional hazards regression models estimating crude and

adjusted hazards ratio and corresponding 95% CIs. Baseline age, education, employment, and living situation were fixed covariates, and sexual and drug use behaviors in the past 4 months were time-dependent covariates in the model. For multivariable analysis, only variables significant in the bivariate analysis at the $p \leq 0.10$ level were entered into the model using a backward elimination variable selection method. The internet-related behavior variables including received a request on the internet to join a 'high party', ever joined a 'high party', and ever joined a 'high party' with men met via the internet were excluded from the multivariable models because these variables were implemented after 2010 and the number of responses were small. Final multivariable models retained only those variables significant at the $p \leq 0.05$ level.

The study protocol was approved by the Ethical Review Committee for Research in Human Subjects of the Thailand Ministry of Public Health, and by the Institutional Review Board of the U.S. Centers for Disease Control and Prevention. We obtained written informed consents from all participants.

Results

A total of 1977 men were recruited during the entire study period and 89.9% (n = 1777) met inclusion criteria. Of 1777 eligible men, 1.9% (n = 33) did not want to participate in the study. Among 1744 men enrolled in BMCS, 40.8% (n = 712) were MSM aged 18–24 years (Fig. 1). Of these, 21.2% (n = 151) were HIV-infected YMSM at enrollment. The follow-up rates among the 561 HIV-uninfected YMSM who enrolled into the study was 83.4% at 12 months, 59.4% at 36 months and 53.7% at 60 months. Of 561 HIV-uninfected YMSM enrolled, 11.9% (n = 67) did not return for any follow-up visits, leaving a total of 88.1% (n = 494) participants to contribute data from April 2006 to November 2014 to this analysis.

Socio-Demographic and Behavioral Characteristics (n = 494)

Socio-demographic and behavioral characteristics are described in Table 1. At baseline, participant's mean age was 21.6 years (standard deviation = 1.8 years), 49.2% (n = 243) completed high school, and 20.9% (n = 103) completed vocational or technical school. Among our study sample, 47.8% (n = 236) were in school and 22.7% (n = 112) were both working and in school. The median age for first anal sexual intercourse with another male was 18 years (interquartile range = 16–19 years). For lifetime sexual partners, 74.7% (n = 369) ever reported both steady and casual partners, and 16.8% (n = 83) reported only a steady partner. Of 371 YMSM who reported having male steady partners in the past 4 months, 44.2% (n = 164) reported only one male steady partner and 55.8% (n = 207) reported more than one male steady partners. Among 344 YMSM who reported having male casual partners in the past 4 months, 85.2% (n = 293) had had more than one male casual partner. Inconsistent condom use with male steady partners and casual partners in the past 4 months occurred in 64.4% (n = 239), and 43.0% (n = 148) participants, respectively (Table 1).

In 392 YMSM who were asked about internet use, 71.4% (n = 280) had used the internet to look for sexual partners, 29.3% (n = 115) had used the internet to have online sex, 50.3% (n = 197) had received a request on the internet to join a 'high party', 18.1% (n = 71) had ever

joined a ‘high party’, and 14.3% (n = 56) ever joined a ‘high party’ with men met via the internet (Table 1).

HIV Prevalence and HIV Incidence

Baseline HIV prevalence among 712 YMSM was 21.2% (95% CI 18.3–24.4). YMSM with HIV prevalence were more likely to be employed (68% vs. 51%; $p < 0.001$) and living with their partners (18% vs. 9%; $p = 0.03$). HIV prevalence was strongly associated with age, 8.3% in 18 year-old YMSM increasing to 28.9% in 24 year-old YMSM ($p = 0.0002$). In multivariable logistic regression analysis, demographic factors significantly associated with HIV prevalence at baseline included older age group (adjusted odds ratio [AOR] = 1.5; 95% CI 1.1–2.3), being employed (AOR = 1.7; 95% CI 1.2–2.6), and living with their partners (AOR = 2.3; 95% CI 1.3–4.1) (Table 2).

The 494 HIV-uninfected YMSM contributed 1647 PY of follow-up time (median follow-up, 3.3 years, range, 0.01–5.1 years). We detected 122 seroconversions for an overall HIV incidence of 7.4 per 100 PY (95% CI 6.2–8.8); 42.6% (n = 52) had become HIV-infected at aged 25–29 years. Since 2010 we identified 26 YMSM with acute or early HIV infection after a total of 2246 NAAT or fourth generation EIA tests. The acute and early HIV infection rate was 1.2 per 100 tests (95% CI 0.8–1.7). The Kaplan–Meier estimate of the 5 year cumulative HIV-uninfected YMSM was 66.5% (95% CI 61.1–71.3) (Fig. 2). We found HIV incidence density was high among YMSM using club drugs to enhance sexual pleasure (23.6 per 100 PY; 95% CI 12.6–40.4) and those using erectile dysfunction drugs in combination with club drugs (19.4 per 100 PY; 95% CI 7.1–42.1). Among YMSM with testing positive for an STI, HIV incidence density was highest among YMSM who had anti-HAV positive before HIV seroconversion (69.6 per 100 PY; 95% CI 39.8–113.0), followed by presence of rectal CT (65.1 per 100 PY; 95% CI 43.3–94.1), and presence of *T. pallidum* before HIV seroconversion (64.3 per 100 PY; 95% CI 29.4–122.0), respectively. The number of seroconversion cases/PY and incidence density were shown in Table 1.

Risk Factors for HIV Incidence in YMSM

In bivariate Cox proportional hazard analysis, having used club drugs to enhance sexual pleasure (hazard ratio [HR] = 3.6; 95% CI 2.0–6.5), having used erectile dysfunction drugs (HR = 2.4; 95% CI 1.4–4.0), having used erectile dysfunction drugs in combination with club drugs (HR = 3.2; 95% CI 1.4–7.2), and living alone or with roommate (HR = 1.8; 95% CI 1.2–2.6), were all significantly associated with HIV incidence. Other sexual risk behaviors also significantly associated with HIV incidence included: having receptive or both insertive and receptive anal intercourse with men (HR = 5.4; 95% CI 2.0–14.6), not always using condoms with male steady partners (HR = 1.8; 95% CI 1.1–2.8), having 2 or more male casual partners (HR = 1.9; 95% CI 1.2–2.8), not always using condoms with male casual partners (HR = 2.1; 95% CI 1.3–3.1), having group sex (HR = 1.8; 95% CI 1.2–2.8), presence of rectal NG before HIV seroconversion (HR = 7.1; 95% CI 3.6–14.1), presence of rectal CT (HR = 10.2; 95% CI 6.6–15.9), presence of anti-HAV (HR = 10.2; 95% CI 5.9–17.5), and presence of anti-HBc (HR = 10.3; 95% CI 7.1–14.9), presence of HSV-2 (HR = 7.1; 95% CI 4.5–11.1), and presence of *T. pallidum* before HIV seroconversion (HR = 7.9; 95% CI 4.0–15.8).

In multivariable Cox proportional hazard analysis, factors significantly and independently associated with HIV incidence included using erectile dysfunction drugs in combination with club drugs (adjusted hazard ratio [AHR] = 6.1; 95% CI 2.0–18.5), having receptive or both insertive and receptive anal intercourse with men (AHR = 4.7; 95% CI 1.4–15.3), not always using condoms with male steady partners (AHR = 2.2; 95% CI 1.1–4.0), presence of rectal CT (AHR = 3.0; 95% CI 1.4–6.2), presence of anti-HAV (AHR = 3.0; 95% CI 1.2–7.5), and presence of anti-HBc before HIV seroconversion (AHR = 2.6; 95% CI 1.3–5.3) (Table 1).

Discussion

In this report we estimate that HIV incidence in YMSM was 7.4 per 100 PY from 2006 to 2014, a rate that is much higher than reported in other key populations in Thailand [31]. The Thailand HIV sentinel surveillance documented that the HIV incidence among male military conscripts was between 0.17–0.39 cases per 100 PY, and has been increasing slowly since 2005 [31]. This study included young men but most were not MSM. Our findings were similar to incidence estimates in YMSM cohorts in China, but were much higher than those found in western countries [3, 5, 9]. Despite significant progress reducing HIV rates among other key populations such as female sex workers and people who inject drugs [32], our results suggest that a high HIV incidence in a different key population, YMSM, is now driving the HIV epidemic in Thailand and may complicate efforts to reach the UNAIDS/WHO 90–90-90 targets.

The HIV incidence was especially high among YMSM with STIs, including rectal CT and HBV. Our findings are consistent with other studies showing that rectal CT and HBV are associated with HIV in MSM [11, 13, 33–35], suggesting presence of STIs could identify YMSM at high risk for acquiring HIV. More effort is needed to improve STI testing, and make treatment facilities available in locations highly frequented by young people in order to increase STI testing uptake by MSM at high risk. In this cohort, we found that having HAV prior to HIV seroconversion was significantly associated with HIV incidence. Although HAV is not a typical STI, ongoing outbreaks of HAV infection among MSM and transmission through sexual contact are well documented [15, 16, 18]. Studies have identified HAV outbreaks linked to sexual high risk behaviors and suggested vaccination against HAV should be considered for MSM populations [36–39]. Unlike data from western countries, the authors are unaware of any studies from Thailand or Southeast Asia demonstrating sexual risk as being associated with HAV infection. Further investigations regarding the association of HAV and HIV acquisition among YMSM in Thailand may be warranted.

Consistent with other studies among MSM in Asian and western countries [10, 11, 40, 41], our study found YMSM reported less consistent condom use with steady male partners than with casual partners. Unfortunately inconsistent condom use with male steady partners was significantly associated with HIV infection. One’s decision to practice sex without a condom may be based on assumptions that a steady partner is not having sex with other men, trusting that one’s partner is HIV-uninfected, or to express love [42]. There is growing evidence that MSM who have unprotected sex with their steady partners, while concurrently having

unprotected sex with their casual partners, have an elevating risk of HIV acquisition [22, 43, 44]. HIV interventions targeting YMSM should further explore attitudes toward condom use and different sexual relationships, acceptable risk-reduction strategies, and promotion of couples HIV-testing.

Drug use for sexual pleasure (club drugs) or erectile dysfunction has also previously been associated with HIV infection [43, 44]. Our analysis found that use of erectile dysfunction drugs in combination with club drugs was associated with incident HIV infection, but using them separately was not. One explanation for this finding is that the drugs contribute to prolonged and repeated sexual intercourse by increasing sexual desire and pleasure and by prolonging erectile function. Other factors may also contribute to this finding including, less consistent condom use or more risk taking behaviors (i.e. fisting, other sex acts) when both types of drugs are being used [23, 45, 46]. Availability of pre-exposure prophylaxis (PrEP) and condoms prior to the high parties or other venues where club drugs and erectile dysfunction drugs are used could help target those at greatest risk.

Our study has a number of limitations. Men were recruited using non-probability sampling that may not represent all MSM populations in Bangkok. In addition, the study was conducted in a single location in Bangkok, Thailand, and may not be representative of findings from other locations in Thailand or Asia. Self-report of behaviors in the past 4 months may be subject to recall bias. Social desirability bias, given self-report of sexual, alcohol and drug use behaviors, may limit our ability to generate accurate estimates as these topics remain stigmatizing and sensitive. However, we provided ACASI in a private setting to minimize social desirability bias, ensure confidentiality, and support disclosure of sensitive behaviors. In addition, loss to follow up may have introduced bias. We did not examine if loss to follow-up impacted the results for YMSM. However an evaluation of loss to follow up from this cohort published recently showed that loss to follow up resulted in an underestimate of association between HIV prevalence and unprotected anal sex with any partners [47]. This study has several strengths, including the long period of follow-up (every 4 months for up to 5 years), the ability to detect acute infection in a high-risk population, and being one of the few studies to assess HIV incidence in YMSM, and the only one in Bangkok, Thailand.

This study provides the foundation for future work in HIV prevention for YMSM. Young MSM are a particularly vulnerable population with many at risk for HIV well before 18 years of age. An upcoming young MSM cohort study in Bangkok scheduled to start in 2017 will seek to describe the epidemic in adolescents and young men as young as 15 years of age. YMSM have specific risks for new HIV infection and linking YMSM to HIV/STI interventions is essential to preventing the spread of HIV and STIs. HIV/STI clinics that meet the specific needs of YMSM should be available and scaled up. The services should include counseling, testing, treatment, and referral and should be delivered in a way that easily provides access, confidential services, a supportive environment, and be free from discrimination. Provision of effective prevention without barriers, including pre-exposure prophylaxis and post-exposure prophylaxis, is essential. Specific policies and programs are needed to reach this population and support HIV prevention goals of the country and region.

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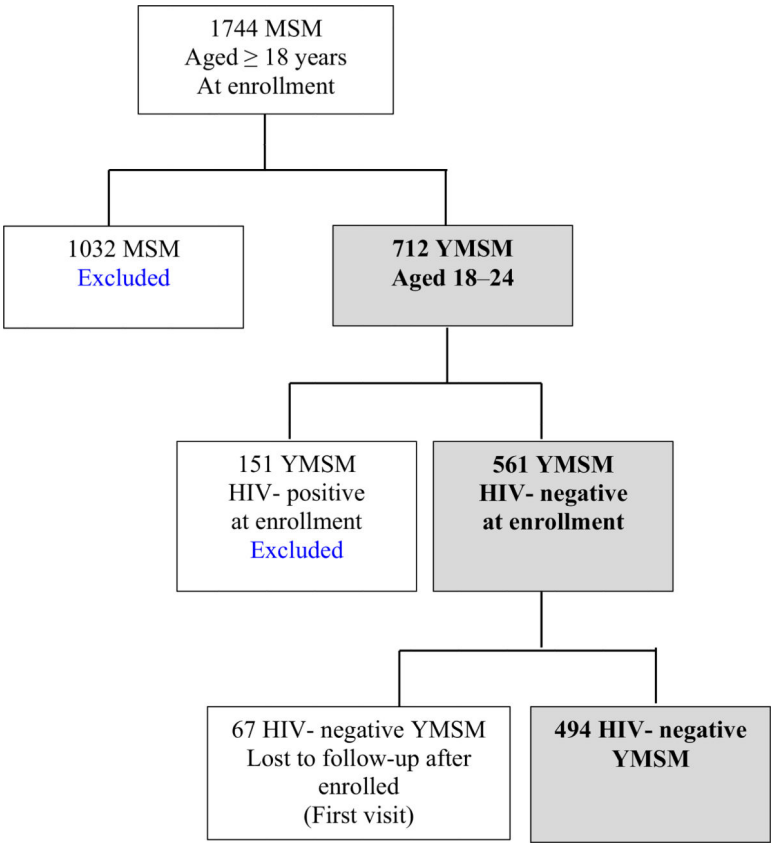

Fig. 1.

Study sample selection from the open longitudinal cohort, Bangkok MSM Cohort Study, Thailand, 2006–2014

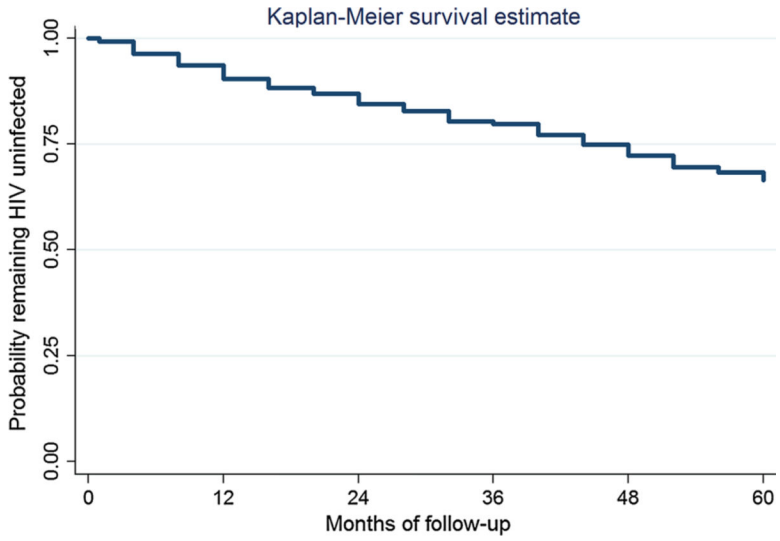

Fig. 2.

Sixty months cumulative probability of remaining HIV-uninfected among young men ages 18–24 years, Bangkok MSM Cohort Study, Thailand, 2006–2014

Table 1

Characteristics of young MSM ages 18–24 years and HIV incidence, bivariate and multivariable model, Bangkok MSM Cohort Study, Thailand, 2006–2014

Characteristics	% (N)	No. of seroconversions cases/PY	Incidence density (95%CI)	Hazard ratio (95% CI)	*p* value	Adjusted hazard ratio (95% CI)	*p* value
Total	100 (494)	122/1647	7.4 (6.2–8.8)	-		-	-
General characteristics							
Age group (years)							
18–21	44.5 (220)	53/692	7.7 (5.7–10.0)	1.1 (0.8–1.5)	0.72	-	-
22–24	55.5 (274)	69/955	7.2 (5.6–9.1)	1			
Highest education							
Secondary school or less	9.7 (48)	10/153	6.5 (3.1–12.0)	1.1 (0.5–2.2)	0.91	-	-
High school/voca- tional school	70.0 (346)	87/1145	7.6 (6.1–9.4)	1.1 (0.7–1.6)	0.82		
University or higher	20.3 (100)	25/349	7.2 (4.6–10.6)	1			
Employment							
Employed	49.6 (245)	57/831	6.9 (5.2–8.9)	1			
Unemployed	50.4 (249)	65/816	8.0 (6.2–10.2)	1.1 (0.8–1.6)	0.49	-	-
Living situation at enrollment							
With family	45.8 (226)	47/836	5.6 (4.1–7.5)	1			
With partner	9.7 (48)	10/161	6.2 (3.0–11.4)	1.1 (0.6–2.2)	0.79		
Alone, roommate	44.5 (220)	65/650	10.0 (7.7–12.8)	1.8 (1.2–2.6)	0.003	NS	
Alcohol and drugs use behaviors							
Binge drinking[a]	14.2 (70)	13/175	7.4 (4.0–12.7)	1.1 (0.6–1.9)	0.88	-	-
Used club drugs[b] to enhance sexual pleasure (past 4 months)	4.5 (22)	13/55	23.6 (12.6–40.4)	3.6 (2.0–6.5)	< 0.001	NS	
Use of erectile dysfunction drugs (past 4 months)	7.1 (35)	17/112	15.2 (8.8–24.3)	2.4 (1.4–4.0)	0.001	NS	
Used erectile dysfunction drugs in combination with club drugs (past 4 months)	1.6 (8)	6/31	19.4 (7.1–42.1)	3.2 (1.4–7.2)	0.006	6.1 (2.0–18.5)	0.001
Internet-related behaviors[c] (n = 392)							
Ever used the internet to look for sexual partners	71.4 (280)	78/1091	7.2 (5.7–8.9)	2.1 (0.8–5.5)	0.12	-	-
Joined online video chat room (Camfrog) (past 4 months)	65.1 (255)	66/961	6.9 (5.3–8.7)	0.9 (0.5–1.8)	0.79	-	-

Characteristics	% (N)	No. of seroconversions cases/PY	Incidence density (95%CI)	Hazard ratio (95% CI)	*p* value	Adjusted hazard ratio (95% CI)	*p* value
Used the internet to have online sex (past 4 months)	29.3 (115)	28/448	6.3 (4.2–9.0)	1.2 (0.8–1.8)	0.52	-	-
Ever received a request on the internet to join a 'high party'	50.3 (197)	64/736	8.7 (6.7–11.1)	1.9 (1.1–3.5)	0.03	-	-
Ever joined a 'high party'	18.1 (71)	26/251	10.4 (6.8–15.2)	4.0 (2.0–8.1)	< 0.001	-	-
Ever joined a 'high party' with men met via the internet	14.3 (56)	23/200	11.5 (7.3–17.3)	4.9 (2.3–10.3)	< 0.001	-	-
Sexual behavior with variety partners							
Age at first anal sex with a man							
15 years or younger	23.1 (114)	30/381	7.9 (5.3–11.2)	1.6 (0.9–2.8)	0.10	NS	
16–19 years	53.2 (263)	71/851	8.3 (6.5–10.5)	1.6 (1.0–2.7)	0.05		
20 years or older	23.7 (117)	21/415	5.1 (3.1–7.7)	1			
Anal sex role with men (past 4 months)							
Receptive only or both	85.0 (420)	102/1013	10.1 (8.2–12.2)	5.4 (2.0–14.6)	0.001	4.7 (1.4–15.3)	0.01
Insertive only	13.0 (64)	16/420	3.8 (2.2–6.2)	2.1 (0.7–6.1)	0.20	1	
No anal sex	2.0 (10)	4/214	1.9 (0.5–4.8)	1		-	
Had steady partners (past 4 months)	75.1 (371)	81/1121	7.2 (5.7–9.0)	0.9 (0.6–1.4)	0.77	-	-
Number of male steady partners (past 4 months)							
0–1	58.1 (287)	87/1279	6.8 (5.5–8.4)	1			
2–5	36.6 (181)	32/339	9.4 (6.5–13.3)	1.4 (0.9–2.1)	0.16		
> 5	5.3 (26)	3/29	10.3 (2.1–30.2)	1.6 (0.5–5.1)	0.42	-	-
Condom use with male steady partners (past 4 months) (n = 371)							
Always	35.6 (132)	32/592	5.4 (3.7–7.6)	1		1	
Not always	64.4 (239)	47/509	9.2 (6.8–12.3)	1.8 (1.1–2.8)	0.01	2.2 (1.1–4.0)	0.02
Had casual partners (past 4 months)	69.6 (344)	89/1034	8.6 (6.9–10.6)	1.6 (1.1–2.3)	0.03	NS	
Number of male casual partner (past 4 months)							
0–1	40.7 (201)	39/797	4.9 (3.5–6.7)	1			
2–5	38.1 (188)	57/622	9.1 (6.9–11.9)	1.9 (1.2–2.8)	0.003		
> 5	21.3 (105)	26/228	11.4 (7.5–16.7)	2.2 (1.3–3.6)	0.002	NS	
Condom use with male casual partners (past 4 months) (n = 344)							
Always	57.0 (196)	55/795	6.9 (5.2–9.0)	1			
Not always	43.0 (148)	34/238	14.3 (9.9–20.0)	2.1 (1.3–3.1)	0.001	NS	

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Characteristics	% (N)	No. of seroconversions cases/PY	Incidence density (95%CI)	Hazard ratio (95% CI)	*p* value	Adjusted hazard ratio (95% CI)	*p* value
Had sex with casual partner at sauna	41.9 (144)	42/389	10.8 (7.8–14.6)	1.4 (0.9–2.2)	0.09	NS	
Paid money, gifts, or valuables for sex (past 4 months)	7.9 (39)	10/96	10.4 (5.0–19.2)	1.4 (0.8–2.8)	0.27	-	-
Condom use with paid partner (past 4 months) (n = 39)							
Always	59.0 (23)	8/72	11.1 (4.8–21.9)	0.9 (0.2–5.0)	0.96	-	-
Not always	41.0 (16)	2/19	10.5 (1.3–38.0)	1			
Received money, gifts, or valuables for sex (past 4 months)	23.5 (116)	16/193	8.3 (4.7–13.5)	1.1 (0.6–1.8)	0.80	-	-
Condom use with partners who paid (past 4 months) (n = 116)							
Always	60.3 (70)	10/157	6.4 (3.1–11.7)	1			
Not always	39.7 (46)	6/35	17.1 (6.3–37.3)	2.1 (0.8–5.9)	0.15	-	-
Had group sex (past 4 months)	29.1 (144)	27/215	12.6 (8.3–18.3)	1.8 (1.2–2.8)	0.005	NS	
Sexually transmitted infection							
Rectal *Neisseria gonorrhea* positive before HIV seroconversion	1.8 (9)	9/16	56.3 (25.7–106.8)	7.1 (3.6–14.1)	< 0.001	NS	
Rectal *Chlamydia trachomatis* positive before HIV seroconversion	5.7 (28)	28/43	65.1 (43.3–94.1)	10.2 (6.6–15.9)	< 0.001	3.0 (1.4–6.2)	0.004
HAV antibody positive before HIV seroconversion	3.2(16)	16/23	69.6 (39.8–113.0)	10.2 (5.9–17.5)	< 0.001	3.0 (1.2–7.5)	0.02
HBc positive before HIV seroconversion	10.7 (53)	53/112	47.3 (35.5–61.9)	10.3 (7.1–14.9)	< 0.001	2.6 (1.3–5.3)	0.006
HSV-2 antibody positive before HIV seroconversion	5.1 (25)	25/53	47.2 (30.5–69.6)	7.1 (4.5–11.1)	< 0.001	NS	
Treponema pallidum antibody positive before HIV seroconversion	1.8 (9)	9/14	64.3 (29.4–122.0)	7.9 (4.0–15.8)	< 0.001	NS	

Incident HIV infection was defined as either seroconversion from HIV-negative to HIV-positive based on rapid HIV tests, or if no seroconversion, HIV infection (acute and early HIV infection) was defined as having nucleic acid amplification testing (NAAT) or 4th generation enzyme immunoassay (EIA) tests positive

PY person-years; *CI* confidence interval; *NS* not significant

[a] Got drunk 2 or 3 times per week or more often

[b] Club drugs: cannabis, ecstasy (MDMA), amphetamine, methamphetamine, ketamine, cocaine, and gammahydroxybutyrate

[c] Internet-related behaviors were excluded from the multivariable models because these variables were implemented after 2010 and the number of participants included were small

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Table 2

Baseline demographic characteristics of young MSM ages 18–24 years and HIV prevalence, bivariate and multivariable model, Bangkok MSM Cohort Study, Thailand, 2006–2014

Characteristics	% (N)	Baseline HIV prevalence % (N)	Odds ratio (95% CI)	*p* value	Adjusted odds ratio (95% CI)	*p* value
Total	100 (712)	21.2 (151)	-	-	-	-
Age (years)						
18–21	44.1 (314)	15.9 (50)	1		1	
22–24	55.9 (398)	25.4 (101)	1.8 (1.2–2.6)	0.002	1.5 (1.1–2.3)	0.03
Highest education						
Secondary school or less	11.9 (85)	21.2 (18)	0.9 (0.5–1.7)	0.76		
High school/vocational school	69.1 (492)	20.7 (102)	0.9 (0.6–1.4)	0.57		
University or higher	19.0 (135)	23.0 (31)	1			
Employment						
Employed	54.5 (388)	26.3 (102)	2.0 (1.4–2.9)	< 0.001	1.7 (1.2–2.6)	0.004
Unemployed	45.5 (324)	15.1 (49)	1		1	0.004
Living situation at enrollment						
With family	42.4 (302)	16.9 (51)	1		1	
With partner	11.1 (79)	34.2 (27)	2.6 (1.5–4.5)	0.001	2.3 (1.3–4.1)	0.003
Alone, roommate	46.5 (331)	22.1 (73)	1.4 (0.9–2.1)	0.10	1.3 (0.9–2.0)	0.17

CI confidence interval