HHS Public Access

Author manuscript

Int J STD AIDS. Author manuscript; available in PMC 2022 December 26.

Published in final edited form as:

Int J STD AIDS. 2020 October ; 31(12): 1154–1160. doi:10.1177/0956462420921068.

HIV incidence among men who have sex with men and transgender women in four provinces in Thailand

Usanee Kritsanavarin[1], **Emily Bloss**[1], **Chomnad Manopaiboon**[1], **Thana Khawcharoenporn**[2], **Pronnipa Harnlakon**[3], **Monthinee Vasanti-Uppapokakorn**[4], **Prapaporn Kitwattanachai**[5], **Supranee Naprasert**[6], **Tharee Phiphatthananon**[7], **Prin Visavakum**[1], **Bongkoch Jetsawang**[1], **Philip A Mock**[1]

[1]Centers for Disease Control and Prevention, Thailand MOPH-US CDC Collaboration, Nonthaburi, Thailand

[2]Thammasat University Hospital, Patum Thani, Thailand

[3]Srinagarind University Hospital, Khon Kaen, Thailand

[4]Bureau of AIDS, TB and STIs, Ministry of Public Health, Nonthaburi, Thailand

[5]Udon Thani Hospital, Udon Thani, Thailand

[6]Khon Kaen Hospital, Khon Kaen, Thailand

[7]Lerdsin Hospital, Bangkok, Thailand

Abstract

The HIV epidemic in Thailand is concentrated in key populations, with the highest rates in men who have sex with men (MSM) and transgender women (TG). Previous studies of HIV incidence in these groups have been limited mostly to Bangkok. We measured HIV incidence in MSM and TG in four provinces and evaluated factors associated with incident infections to inform public health prevention efforts. An analysis was conducted using data collected during a prospective observational cohort study during April 2015–May 2018 in outpatient clinics in five hospitals across four provinces in Thailand. MSM and TG aged ≥18 years, who were not known to be HIV-infected, and who reported anal intercourse with a male or TG without a condom in the past six months were enrolled. Participants were followed-up every 6 months for 18 months with questionnaires and HIV testing. A total of 40 HIV seroconversions occurred during follow-up, resulting in an HIV incidence of 3.5 per 100 person-years (95% CI 2.5, 4.8). Multivariate analyses indicated that identifying as gay (adjusted hazard ratio [AHR] 4.9; 95% CI 1.7–14.2), having receptive anal sex in the past six months (AHR 3.6; 95% CI 1.4–9.5), using alcohol (AHR 3.3; 95% CI 1.3–8.3), and taking alkyl nitrites (AHR 4.4; 95% CI 1.7–11.2) in the past six months were all independently associated with HIV infection. Overall this study found a lower HIV

Corresponding author: Usanee Kritsanavarin, Centers for Disease Control and Prevention, Division of Global HIV&TB (DGHT), Thailand MOPH-US CDC Collaboration, DDC 7 Building, 5th Floor, Ministry of Public Health Soi 4, Muang Nonthaburi, Nonthanuri 11000, Thailand. hpy8@cdc.gov.

Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

incidence in the highest risk population in Thailand compared with similar studies in Bangkok. Accelerated prevention efforts are needed to make the goal of ‘zero new infections’ possible in Thailand.

Keywords

AIDS; incidence; Thailand; men who have sex with men

Background

The HIV epidemic in Thailand is concentrated within large urban areas in key populations, with the highest rates in men who have sex with men (MSM) and transgender women (TG). In 2018, 1446 (29%) of the estimated 4909 new HIV infections were among MSM and TG in Thailand.[1] Previous studies of HIV prevalence and incidence in this population showed increasing trends, which have stabilized and slightly declined in recent years. For example, HIV prevalence in MSM in Bangkok increased from 17.3% to 31.3% during 2003–2010[2,3–5] and then fluctuated around 20% during 2012–2016.[6] Prevalence estimates have varied by province, for example, bio-behavioral survey results found the HIV prevalence in MSM ranged from 19.6% in Bangkok to 2.6% in Khon Kaen.[7] HIV incidence studies among young MSM in Bangkok reported increases from 4.1 to 7.7 per 100 person years between 2003 and 2007,[8] and then averaged 7.4 per 100 person years between 2006 and 2014.[9] HIV incidence rates in Bangkok have stabilized at approximately 6.0 per 100 person-years.[10–12] A study which included MSM in and outside of Bangkok found HIV incidence 6.2 per 100 person years between 2012 and 2016.[12] However, past studies of HIV incidence have largely been limited to Bangkok, so there is a need to better understand new HIV infections in other settings in Thailand.

The government of Thailand has committed to addressing the HIV epidemic in key populations, including MSM and TG. In addition to developing guidelines focusing on prevention within these groups, the government has also committed financial support to cover prevention services nationwide, including condom promotion, HIV testing, and pre-exposure prophylaxis (PrEP) initiation, and initiating antiretroviral therapy (ART) regardless of CD4 cell count.[7,13–15] To measure the impact of these efforts and also monitor the trajectory of the HIV epidemic among key populations, we conducted an analysis to study HIV incidence among MSM and TG from a Test, Treat, and Prevent Program in four provinces and evaluated demographic and behavioral factors associated with incident infections. Results can be used to inform public health prevention efforts.

Methods

Data collection

Prospective cohort data used in the analysis were collected during the period April 2015 to May 2018 to assess a Test, Treat, and Prevent Program conducted among MSM and TG in outpatient clinics in five large urban hospitals in four provinces (Bangkok, Khon Kaen, Udon Thani, Pathum Thani) in Thailand. Sites were selected based on geographic

prioritization of 4 of the 30 high HIV burden provinces in Thailand,[16] volume of MSM and TG clients, provision of HIV services, and willingness to participate in a Test, Treat, and Prevent Program that was implemented to increase HIV testing coverage and access to ART regardless of CD4 level among MSM and TG.[17] Eligible participants included Thai MSM and TG women aged ≥18 years, who were willing to participate, were not known to be HIV-infected, and who reported anal intercourse with a male or TG without a condom in the six months before enrollment. In the clinics trained study staff consented and enrolled participants who met the eligibility criteria.

During the initial visit, participants completed a standardized tablet-based questionnaire and received HIV testing using the three-test algorithm following Thailand's HIV testing guidelines (i.e. Determine HIV-1/2, SD Bioline HIV1/2 3.0, and First Response HIV Card test 1–2.0).[18] Participants were followed-up every 6 months and during each visit they were asked to complete a questionnaire to assess changes in risk behaviors and to have an HIV test to monitor HIV incidence, until they completed 18 months follow-up. Participants with positive HIV test results were offered ART regardless of CD4 level; results and adherence were recorded. Project staff called participants to remind them of each appointment and made follow-up calls for those who did not return. The participants were provided monetary compensation for their time and transportation. In two sites (Lerdsin and Thammasart), PrEP was offered to participants with HIV-negative test results. Those on PrEP were excluded from analyses.

Ethical approval was obtained from the Thailand Ministry of Public Health Ethical Review Committee. The activity was also reviewed in accordance with Centers for Disease Control and Prevention (CDC) human research protection procedures and was determined to be research but CDC investigators did not interact with human subjects or have access to identifiable data or specimens for research purposes. Written informed consent was obtained from all participants.

Statistical analysis

Categorical variables were summarized using counts and percentages, and the median and interquartile range were calculated for continuous variables. HIV incidence rate was calculated as the number of seroconversions divided by the number of person-years of follow-up among those testing HIV-negative at baseline and did not elect to use PrEP. The date of seroconversion was defined as the midpoint between the date of the last HIV-negative and first HIV-positive visits. The person-time contributed in this analysis was calculated from completed follow-up risk evaluation visits at 6, 12 and 18 months. Ninety-five percent confidence intervals (95% CI) were calculated using the exact Poisson method.

Risk factors for time to HIV seroconversion were analyzed using the discrete or grouped time Cox proportional hazards regression model;[19] the grouped time points of infection being each six-month follow-up visit. All Cox regression models included stratification by study site allowing the baseline hazard to vary by site; hazard ratios (HRs) and 95% CIs were estimated from the model. Factors used in the multivariate models were selected based on significance in bivariate analysis ($p < 0.1$) and those of theoretical importance based on previous research. Models included time-independent (fixed) baseline demographic

variables, and the past six-month risk factors as time-dependent covariates. The proportional hazards assumption for the discrete Cox regression analysis was assessed by an interaction effect between time and risk factor.

Participants who missed a follow-up visit resulting in missing data or records were excluded from the analysis. All analyses were performed using SAS, version 9.4 (SAS Institute Corporation, Cary, NC).

Results

Of the 1880 MSM and TG enrolled, there were 303 HIV-positive diagnosed at the time of enrollment. Of the 1577 HIV-negative MSM and TG women, 166 initiated PrEP, which led to 1411 total eligible for the analysis. At baseline the median age was 22 (IQ range 19–29) years, with 642 (46%) under 22 years.

Over one-third (n = 459, 33%) had more than a secondary education (Table 1). Half of participants identified as gay (49%), while fewer identified as transsexual (25%), heterosexual (21%), or bisexual (5%). The majority (n = 839, 63%) reported receptive anal sex in the six months prior to enrollment, and among those, 682 (81%) reported inconsistent condom use (data not shown). Approximately half (n = 708, 53%) reported insertive anal sex in the past six months, and of those 552 (78%) inconsistently used condoms (data not shown). However, when having sex with HIV-positive partners, 97% reported using a condom. Alcohol and drug use were reported from less than 10% of participants. In a sub-analysis, TG women were significantly more likely to practice receptive anal sex (p < 0.001), and less likely to use poppers (p = 0.03) compared to the other groups (data not shown).

There were a total of 40 HIV seroconversions during follow-up, resulting in an HIV incidence of 3.5 per 100 person-years (95% CI 2.5, 4.8; Table 2). Nineteen (48%) seroconversions happened during the first 6 months, 11 (28%) during 6–12 months, and 10 (25%) during 13–18 months (data not shown). Though not statistically significant, the rate was highest in Udon Thani hospital (5.2 per 100 person-years, 95% CI 3.2–8.0), and was lowest in Sri Nakarin (2.2 per 100 person-years, 95% CI 1.2–4.2). The HIV incidence on PrEP was 1/113.3 person-years or 0.9 per 100 person-years (95% CI: 0.02, 4.9), and overall incidence regardless of PrEP was 41/1245.8 person-years or 3.3 per 100 person-years (95% CI 2.36, 4.46). There was a decrease in retention over time, with 754 (53%) at 6 months, 582 (42%) at 12 months, and 578 (41%) at 18 months. Overall retention was highest in Sri Nakarin (82%), followed by Udon Thani (77%), Thammasat (49%), Khon Kaen (40%), and Lerdsin (29%); retention rates within hospitals were similar across follow-up periods. Factors associated with loss-to-follow-up were younger age, lower education, and self-identifying as heterosexual or bisexual. The most common reasons for loss-to-follow-up were moving location of work or education to outside the study area.

Multivariate analysis indicated that identifying as gay (adjusted hazard ratio [AHR] 4.9; 95% CI 1.7–14.2), having receptive anal sex in the past six months (AHR 3.6; 95% CI 1.4–9.5), using alcohol (AHR 3.3; 95% CI 1.3–8.3), and taking alkyl nitrites (or ‘poppers’)

(AHR 4.4; 95% CI 1.7–11.2) in the past six months were all independently associated with HIV incidence (Table 1).

Discussion

In this study of a large cohort of MSM and TG in four provinces in Thailand HIV incidence was 3.5 per 100 person-years, which is lower than previously reported rates of approximately 5–6 per 100 person-years in Bangkok.[11,12] Results are consistent with incidence rates seen in recent studies using repeated HIV testing at mobile and VCT clinics and contributes to evidence to suggest a decline in HIV incidence in the highest risk population in Thailand.[12,20] However, there is still substantial room to improve the clinical cascade for MSM and TG in Thailand. In Bangkok, an estimated 26% of MSM living with HIV know their status, 54% are on treatment, and 65% are virally suppressed, but the estimates vary across the country. For example, among MSM in Khon Kaen approximately 33% know their status, 71% are on treatment, and 72% are virally suppressed. Estimated coverage for condom use was 79% among MSM and 81% among TG in 2016.[7] To meet the national goal of ending AIDS by 2030, there needs to be continued and accelerated progress in reducing HIV infections in key populations. The Royal Thai Government has demonstrated a national commitment to increase programmatic and financial support to scale up prevention, care, and treatment services for MSM and TG.[13,14] In 2017, the Ministry of Public Health published national HIV guidelines that prioritized the scale-up of treatment and prevention efforts in this population.[21]

Differences were observed in HIV incidence by site, with Udon Thani Hospital having the highest rate of new infections. Programmatic data in the province found similarly high HIV incidence of 5.8 per 100 person-years (95% CI 2.8, 10.07).[12] This regional hospital, which is located in a central district within Udon Thani Province in the northeastern part of the country, has a busy one-stop HIV testing and care clinic with long-standing MSM and TG-friendly services.[2] The higher incidence may be a reflection of a small sexual network in a setting with a high HIV prevalence.

Several risk factors for HIV infection among MSM and TG were identified, including receptive anal sex, and recent alcohol and popper use. Previous HIV incidence studies have found similar results for anal receptive sex and alcohol.[11] Inhalation of alkyl nitrites (or ‘poppers’) are used to induce short-term increase in sexual sensation and have been associated with HIV prevalence among MSM and TG in Bangkok previously.[11,22] Use of methamphetamine and drugs for erectile dysfunction were not related to HIV infection in this study, unlike other studies of similar populations.[23] Drug use impairs judgment and can lead to higher risk behaviors during sex. Incorporating drug use harm reduction messages within HIV prevention programs may help address this risk.[24,25] In other studies young age has been associated with HIV incidence, and may be related with increased risk taking and greater exposure to susceptible and recently HIV-infected partners.[11] Age was not found to be a predictor of HIV incidence in this study. This may be because this cohort was younger compared with other studies, so differences were not detectable.

Despite national education campaigns and efforts to promote condom use, including distribution of free condoms among MSM and TG, the estimated national coverage for condoms remains sub-optimal, at 79% among MSM and 81% among TG in 2016.[7] This study demonstrated a high prevalence of inconsistent condom use, as well as other risk behaviors. Expanding access to proven targeted HIV prevention programs, better understanding of sexual behaviors, reinforcing condom use, expanding treatment as prevention and increasing awareness and access to PrEP and PEP could help reduce the HIV epidemic among MSM and TG in Thailand.[12,26,27] In 2019, Thailand implemented PrEP under the national health insurance scheme for high-risk groups, including MSM and TG,[28] which has helped accelerate the expansion of PrEP services nationally, including in the four provinces in this study. As a part of combination programs non-occupational post exposure prophylaxis was recommended in the 2017 national guidelines.[14]

This study has several limitations. First, this study was part of a larger project with multiple objectives, including a program to increase testing coverage and access to ART, and, as such, this may limit the generalizability of results to all provinces in Thailand. Second, there was relatively high loss to follow-up and short follow-up time during the study, particularly in the first six months, which could affect interpretation of the results. To increase retention, bi-directional texting through SMS may be a suitable approach, as it has been shown to be an acceptable and effective method to improve PrEP adherence and retention between young HIV-positive clients and providers in these sites.[29] Third, the observed incidence was 3.5 per 100 person-years, and we expected a 5% HIV incidence, which resulted in fewer cases than expected, and hence the risk factor analysis was limited by the small number of seroconvertors for a stratified analysis. Given the challenges of measuring HIV incidence, Thailand is currently rolling out the use of assays to identify and distinguish recent from long-term HIV-1 infection. This approach can contribute to the understanding of transmission dynamics, and can be used to estimate HIV incidence (rate of new infection, or recency) for impact assessment and targeted prevention. Finally, while the questionnaires were comprehensive in the collection of risk factor information, it is possible that some HIV risk factors were not accounted for in this analysis. A strength of this large prospective cohort study was that it was broad in scope, including sites both in and outside of Bangkok, so findings may be more generalizable to MSM and TG in Thailand compared to similar studies.

Recent prevalence and incidence results combined with the results of this study suggest a change in trajectory in the HIV epidemic among MSM and TG in Thailand. Accelerated efforts, such as expanding access to PrEP and PEP, increasing rapid HIV testing and early ART initiation among MSM and TG, improving viral load suppression among those who are HIV-infected in the continuum of HIV care will make the goal of ‘zero AIDS deaths’ and ‘zero new infections’ possible.

Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This research was funded by the President’s Emergency Plan for AIDS Relief (PEPFAR) through the Centers for Disease Control and Prevention (CDC) under the terms of co-ag # 5 NU2GGH001923.

References

1. AIDS Epidemic Models, Thailand Projection & Estimation Working Group, Ministry of Public Health, Thailand, 2018.
2. van Griensven F, Phanuphak N and Srithanaviboonchai K. Biomedical HIV prevention research and epidemic control in Thailand: two sides of the same coin. Sex Health 2014; 11: 180–199. [PubMed: 25000363]
3. van Griensven F, Varangrat A, Wimonsate W, et al. Trends in HIV prevalence, estimated HIV incidence and risk behavior among men who have sex with men in Bangkok, Thailand, 2003–2007. J Acquir Immune Defic Syndr 2010; 53: 234–239. [PubMed: 19901844]
4. van Griensven F, Thanprasertsuk W, Jommaroeng R, et al. Evidence of a previously undocumented epidemic of HIV infection among men who have sex with men in Bangkok, Thailand. AIDS 2005; 19: 521–526. [PubMed: 15764858]
5. Chanmanee S, Chanmanee P and Seangwanloi O. Results of HIV biological and behavior survey among men who have sex with men. Ministry of Public Health, Thailand, 2012.
6. National AIDS Committee. Thailand progress report for Thailand ending AIDS 2018 (For the implementation period of 1 October 2016–30 September 2017), www.unaids.org>documents>THA_2017_countryreport (2018, accessed 3 January 2019).
7. Thailand National Committee for HIV and AIDS Prevention and Alleviation November 2007. The National Plan for Strategic and Integrated HIV and AIDS Prevention and Alleviation 2007–2011: key contents. Ministry of Public Health, Thailand, 2007.
8. Van Griensven F, Varangrat A, Wimonsate W, et al. Trends in HIV prevalence, estimated HIV incidence and risk behavior among men who have sex with men in Bangkok, Thailand, 2003–2007. J Aquir Immune Defic Syndr 2010; 53: 234–239.
9. Warunee T, van Griensven F, Mock PA, et al. Young men who have sex with men at high risk for HIV, Bangkok MSM cohort study, Thailand 2006–2014. AIDS Behav 2018; 22: 2137–2146. [PubMed: 29138981]
10. van Griensven F, Thienkrua W, McNicholl J, et al. Evidence of an explosive epidemic of HIV infection in a cohort of men who have sex with men in Thailand. AIDS 2013; 27: 825–832. [PubMed: 23169330]
11. van Griensven F, Holtz TH, Thienkrua W, et al. Temporal trends in HIV-1 incidence and risk behaviours in men who have sex with men in Bangkok, Thailand, 2006–13. An observational study. Lancet HIV 2015; 2: e64–70. [PubMed: 26424462]
12. Wasantioopapokakorn M, Manopaiboon C, Phoorisri T, et al. Implementation and assessment of a model to increase HIV testing among men who have sex with men and transgender women in Thailand, 2011–2016. AIDS Care 2018; 30: 1239–1245. [PubMed: 29950108]
13. National AIDS Committee, Thailand. Thailand Ending AIDS. AIDS response progress report, www.unaids.org/sites/default/files/country/documents/THA_narrative_report_2015.pdf (2015, accessed 26 November 2018).
14. Thailand Ministry of Public Health. Thailand National Guidelines on HIV/AIDS treatment and prevention 2017. Thailand Ministry of Public Health, Thailand, 2017, p.74.
15. Ministry of Public Health. Thailand national guidelines on pre-exposure prophylaxis: HIV-PrEP 2018. Bureau of AIDS, TB and STI, Thailand, 2018.
16. National AIDS Committee, Thailand. Thailand national operational plan accelerating ending AIDS 2015–2019, 2019, www.aidsdatahub.org>sites>defult>files>publication (accessed 24 January 2020).
17. Ongwandee S, Lertpiriyasuwat C, Khawcharoenporn T, et al. Implementation of a Test, Treat, and Prevent HIV program among men who have sex with men and transgender women in Thailand,2015–2016. PLoS One 2018; 13: e0201171.
18. Department of Disease Control, Thailand Ministry of Public Health. Guideline on HIV counseling and testing for same day result, Thailand Ministry of Public Health, Thailand, 2013.
19. Prentice RL and Gloeckler LA. Regression analysis of group survival data with application to breast cancer data. Biometrics 1978; 34: 57–67. [PubMed: 630037]

20. Holtz TH, Wimonsate W, Mock PA, et al. Why we need pre-exposure prophylaxis: incident HIV and syphilis among men, and transgender women, who have sex with men, Bangkok, Thailand, 2005–2015. Int J STD AIDS. 2019; 30: 430–435. [PubMed: 30626283]
21. Thailand Ministry of Public Health. Thailand National Guidelines on HIV/AIDS treatment and prevention 2017. Thailand Ministry of Public Health, Thailand, 2017, pp.158–161, 343–368.
22. Lam CR, Holtz TH, Leelawiwat W, et al. Subtypes and risk behaviors among incident HIV cases in the Bangkok men who have sex with men cohort study, Thailand, 2006–2014. AIDS Res Hum Retroviruses 2017; 33: 2018–2026.
23. Piyaraj P, van Griensven F, Holtz TH, et al. The finding of casual sex partners on the internet, methamphetamine use for sexual pleasure, and incidence of HIV infection among men who have sex with men in Bangkok, Thailand: an observational cohort study. Lancet 2018; 5: e379–e389.
24. Coates TJ and Richter L. Behavioural strategies to reduce HIV transmission: how to make them work better. Lancet 2008; 372: 669–684. [PubMed: 18687459]
25. Macdonald V and Nacapew S. IDPC briefing paper. Drug control and harm reduction in Thailand. International Drug Policy Consortium, November 2013.
26. Phanuphak N, Chamnan P, Pathipvanich P, et al. Unsuccessful behavioral risk reduction contributed to HIV seroconversion as well as high STI incidence among newly diagnosed HIV-positive MSM and TG in a facility-based test and treat cohort Thailand. In: 9th IAS conference on HIV science, Palais des Congrès, Paris, France, 23–26 July 2017.
27. Phanuphak N, Sungsing T, Jantarapakde J, et al. Princess PrEP program: the first key population-led model to deliver pre-exposure prophylaxis to key populations by key populations in Thailand. Sex Health. 2018; 15: 542–555. [PubMed: 30249317]
28. Thailand National Health Security Office. https://www.nhso.go.th/FrontEnd/NewsInformationDetail.aspx?newsid=MjYxOQ== (2019, accessed 27 January 2020).
29. Liu AY, Vittinghoff E, von Felten P, et al. Randomized controlled trial of a mobile health intervention to promote retention and adherence to preexposure prophylaxis among young people at risk for human immunodeficiency virus: the EPIC study. Clin Infect Dis 2019; 68: 2010–2017. [PubMed: 30239620]

Int J STD AIDS. Author manuscript; available in PMC 2022 December 26.

Table 1.

Demographic and behavioral factors associated with HIV incidence in MSM and TG in Thailand (***N*** = 1411).

Factor	n	%	Events	Person-years	Rate	95% CI	HR	95% CI	p value	HR (adj)	95% CI	p value
All HIV-negative participants	1411	(100)	40	986.5*	4.05	2.90, 5.52						
Demographic												
Site												
Khon Kaen	305	(22)	4	121.1	3.3	0.90, 8.45	1.03	0.29, 3.64	0.14			
Sri Nakarin	362	(26)	9	354.6	2.54	1.16, 4.82	0.76	0.27, 2.12				
Udon Thani	377	(27)	20	330.9	6.04	3.69, 9.36	1.81	0.73, 4.51				
Lerdsin	28	(2)	1	6.5	15.4	0.39, 85.72	4.4	0.53, 36.68				
Thammasat	339	(24)	6	173.4	3.46	1.27, 7.53	1					
Age (years)												
18–21	642	(46)	18	409.6	4.39	2.61, 6.95	1.86	0.73, 4.74	0.24			
22–29	443	(31)	16	302.6	5.29	3.02, 8.59	2.27	0.88, 5.85				
30+	326	(23)	6	274.3	2.19	0.80, 4.76	1					
Education												
Primary	154	(11)	3	121	2.48	0.51, 7.24	0.69	0.19, 2.44	0.84			
Secondary/vocational	795	(57)	21	504.1	4.17	2.58, 6.37	0.92	0.47, 1.78				
University	459	(33)	16	359.4	4.45	2.54, 7.23	1					
Income (baht)												
<5000	480	(34)	9	329.1	2.74	1.25, 5.19	0.59	0.23, 1.49	0.37			
5000–10,000	632	(45)	21	449.9	4.67	2.89, 7.13	1.03	0.48, 2.20				
10,000+	296	(21)	10	205.6	4.86	2.33, 8.95	1					
Age at first sex												
<13 y	94	(7)	3	70	4.71	0.97, 13.7	1.28	0.38, 4.31	0.88			
14–16 y	578	(41)	15	384.7	3.9	2.18, 6.43	0.93	0.48, 1.81				
17+ y	736	(52)	22	536.1	4.1	2.57, 6.21	1					
Gender identity												
Heterosexual	297	(21)	2	161.5	1.24	0.15, 4.48	0.92	0.17, 5.03	0.01	2.51	0.44, 14.23	0.025
Gay	686	(49)	33	513.7	6.42	4.42, 9.0	4.17	1.47, 11.80		4.92	1.70, 14.22	
Bisexual	71	(5)	1	43.9	2.28	0.06, 12.7	1.45	0.16, 13.19		2.41	0.25, 22.90	

Factor	n	%	Events	Person-years	Rate	95% CI	HR	95% CI	p value	HR (adj)	95% CI	p value
Transsexual	354	(25)	4	265.5	1.51	0.41, 3.86	1			1		
Sexual behavior activity (*n* = 1339)												
Circumcision												
Yes	136	(10)	2	82.1	2.44	0.29, 8.80	0.55	0.13, 2.30	0.41			
No	1272	(90)	38	902.4	4.21	2.98, 5.78	1					
Unprotected sex with HIV+ partner (past 6 m)												
Yes	36	(3)	2	23.6	8.47	1.03, 30.6	1.96	0.47, 8.26	0.36			
No	1303	(97)	38	821.7	4.62	3.27, 6.35	1					
Receptive anal sex (past 6 m)												
Yes	839	(63)	35	512	6.84	4.76, 9.51	3.51	1.37, 8.99	0.009	3.62	1.38, 9.49	0.009
No	500	(37)	5	265.8	1.88	0.61, 4.39	1		1			
Insertive anal sex (past 6 m)												
Yes	708	(53)	27	411.9	6.55	4.32, 9.54	2.19	1.12, 4.27	0.021			
No	631	(47)	13	433.4	3	1.60, 5.13	1					
Anal sex (past 6 m)												
Yes	1169	(87)	39	713.4	5.47	3.89, 7.47	6.77	0.93, 49.35	0.06			
No	170	(13)	1	131.9	0.76	0.02, 4.22	1					
Condom use (past 6 m)												
Always	188	(14)	10	318.3	3.14	1.51, 5.78	1		0.008			
Not always	981	(73)	29	395.1	7.34	4.91, 10.54	2.45	1.19, 5.06				
No anal intercourse partner	170	(12)	1	131.9	0.76	0.02, 42.24	0.26	0.03, 2.07				
Steady partner (past 6 m)												
Yes	662	(49)	24	487.2	4.93	3.16, 7.33	1.08	0.57, 2.04	0.82			
No	677	(51)	16	358	4.47	2.55, 7.26	1					
Casual partner (past 6 m)												
Yes	924	(69)	31	532.6	5.82	3.96, 8.26	1.85	0.96, 4.25	0.06			
No	415	(31)	9	312.7	2.88	1.32, 5.46	1					
Paid partners (past 6 m)												
Yes	213	(16)	6	100.2	5.99	2.19, 13.0	1.51	0.63, 3.65	0.36			
No	1126	(84)	34	745.1	4.56	3.16, 6.38	1					
Sell sex (past 6 m)												

Int J STD AIDS. Author manuscript; available in PMC 2022 December 26.

Factor	n	%	Events	Person-years	Rate	95% CI	HR	95% CI	p value	HR (adj)	95% CI	p value
Yes	283	(21)	7	149.2	4.69	1.89, 9.67	1.05	0.46, 2.40	0.9			
No	1056	(79)	33	696.1	4.74	3.26, 6.66	1					
Drug and alcohol (*n* = 1408)												
IDU partners (past 6 m)												
Yes	51	(4)	5	43.5	11.5	3.73, 26.79	3.83	1.48, 9.92	0.006			
No	1357	(96)	35	942.9	3.71	2.59, 5.16	1					
Injected drugs (past 6 m)												
Yes	26	(2)	2	22.5	8.9	1.08, 32.16	2.13	0.51, 8.89	0.3			
No	1382	(98)	38	964	3.94	2.79, 5.41	1					
Drug use (past 6 m)												
Yes	130	(9)	10	76	13.16	6.31, 24.19	4.02	1.96, 8.25	0.001			
No	1278	(91)	30	910.4	3.29	2.22, 4.70	1					
Alcohol (past 6 m)												
Yes	79	(6)	6	38.8	15.5	5.67, 33.6	4.55	1.90, 10.89	0.001	3.29	1.30, 8.32	0.012
No	1329	(94)	34	947.6	3.59	2.48, 5.01	1			1		
Methamphetamines (past 6 m)												
Yes	46	(3)	3	27.25	11	2.27, 32.17	2.99	0.91, 9.75	0.07			
No	1362	(97)	37	959.2	3.86	2.72, 5.31	1					
Ecstasy (past 6 m)												
Yes	5	(0)	0	3.01	0	0, 1.22	0	NA				
No	1403	(100)	40	983.5	4.07	2.90, 5.54	1					
Poppers (past 6 m)												
Yes	14	(1)	6	15.51	38.68	14.19, 84.19	10.17	4.15, 24.92	<0.001	4.38	1.70, 11.23	0.002
No	1394	(99)	34	970.9	3.51	2.43, 4.89	1			1		
Cocaine (past 6 m)												
Yes	2	(0)	0	1.59	0	0, 2.32	0	NA				
No	1406	(100)	40	984.9	4.06	2.90, 5.53	1					
Marijuana (past 6 m)												
Yes	0	(0)	0	1.1	0	0, 3.39	0	NA				
No	1408	(100)	40	985.4	4.06	2.9, 5.53	1					
Other risk factors (*n* = 1408)												

Int J STD AIDS. Author manuscript; available in PMC 2022 December 26.

Factor	n	%	Events	Person-years	Rate	95% CI	HR	95% CI	p value	HR (adj)	95% CI	p value
Erectile dysfunction drug (past 6 m)												
Yes	14	(1)	0	7.7	0	0, 0.5	0	NA				
No	1394	(99)	40	978.8	4.09	2.92, 5.56	1					
STIs (past 6 m)												
Yes	84	(6)	6	58.4	10.28	3.77, 22.37	2.85	1.19, 6.81	0.02			
No	1324	(94)	34	928.1	3.66	2.53, 5.12	1					

Risk factor analysis total incidence was 4.05, 95% CI (2.9, 5.5), person-years based on completed risk data during follow-up. All models adjusted for study site. Counts and percentages may not add up to total due to missing data or not applicable data.

Table 2.

HIV incidence[a] by site.

Site	n	Events	Person (years)	Rate/100	95% CI
Khon Kaen	305	4	144.4	2.76	0.75, 7.07
Sri Nakarin	362	9	405.2	2.22	1.02, 4.22
Udon Thani	377	20	385.1	5.19	3.17, 8.02
Lerdsin	28	1	6.5	15.38	0.39, 85.7
Thammasat	339	6	203.4	2.95	1.08, 6.42
Overall	1411	40	1132.5	3.53	2.52, 4.80

[a]Based on time to last HIV test.