ORIGINAL RESEARCH ARTICLE

Prevalence of *Treponema pallidum* seropositivity and herpes simplex virus type 2 infection in a cohort of men who have sex with men, Bangkok, Thailand, 2006–2010

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Summary: We report prevalence of *Treponema pallidum* (TP) seropositivity and herpes simplex virus type 2 (HSV-2) infection and risk factors associated with their prevalence in a cohort of men who have sex with men (MSM) in Bangkok, Thailand. Between April 2006 and March 2010 we enrolled Thai MSM into a cohort study based at the Silom Community Clinic, with baseline behavioural data and laboratory testing for sexually transmitted infections (STIs). Logistic regression was used to analyse risk factors associated with the prevalence of TP seropositivity and HSV-2 infection. From a total of 1544 enrolled men (mean age 26 years) TP, HSV-2 and HIV seropositive rates were 4.4%, 20.7% and 21.6%, respectively. After multivariable analysis, participating in group sex, reporting paying for sex, reporting sex with a casual partner in a park and being HSV-2 seropositive were associated with TP prevalence. Age $\geq$30 years, having less than a high school education, past use of recreational drugs, meeting casual sexual partners at a public venue (sauna) and TP seropositivity were associated with HSV-2 infection. The significant baseline prevalence of TP seropositivity and HSV-2 infection in this cohort demonstrates the need for screening and treatment of these STIs and targeted prevention interventions in Thai MSM in Bangkok.

Keywords: sexually transmitted infections, *Treponema pallidum*, syphilis, herpes simplex virus type 2, HSV-2, prevalence, risk factors, men who have sex with men, Thailand

INTRODUCTION

Since the mid-1990s, there has been an increase in notifications of newly diagnosed sexually transmitted infections (STIs) in men who have sex with men (MSM) in western Europe, north America, Australia and the developed economies of east Asia.[1–3] This includes *Chlamydia trachomatis*, *Neisseria gonorrhoeae*, syphilis (*Treponema pallidum* [TP] as the causative organism, not a synonym for current disease) and herpes simplex virus type 2 (HSV-2). The rise has coincided with a significant decrease in HIV-associated mortality and morbidity following the introduction of combination antiretroviral therapy (cART), a corresponding increase in the number of MSM living with HIV, 'safer sex fatigue' in new cohorts of younger MSM who had not personally experienced the devastating effects of AIDS and an increase in unsafe sexual behaviour as a result of 'treatment optimism'.[4] The perception among MSM that HIV transmission risk can be reduced through the use of cART and sophisticated risk-reduction methods among MSM (such as serosorting, negotiated safety, strategic positioning in anal and oral sex and pre-ejaculation withdrawal) may further contribute to complacency regarding HIV risk and parallel an increase in unsafe sexual behaviour.[5,6] However, these measures as well as antiretroviral drugs may not protect against the acquisition of STIs in men (a protective effect of tenofovir 1% gel against the acquisition of HIV[7] and against HSV-2 has been shown only in women[8]), resulting in a greater opportunity for the transmission of STIs among MSM. Reports of ulcerative STIs, such as syphilis and HSV-2 among MSM, are particularly worrisome since these may facilitate the transmission of HIV.[9] On top of that, a recent clinical trial showed no effect of suppressive aciclovir treatment of HSV-2 on the risk of onward HIV transmission.[10]

In particular, reports of newly diagnosed cases of syphilis have increased in multiple industrialized countries since the beginning of the century, partly as a result of transmission among MSM.[1,11–17] The consistency of findings across industrialized countries suggests an increasing connectivity within the global MSM community; a community that is decreasingly defined by geographic boundaries and, in the era of the Internet and easier foreign travel, increasingly linked by shared interests and social and sexual networks.[18] This is powerfully demonstrated in the near-simultaneous increase in

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clinical syphilis among MSM in Europe, the US and other industrialized nations. In contrast, in most lower and middle-income countries (such as Thailand) the prevalence and incidence of syphilis is not very well documented. In 2009, 2076 cases of syphilis were reported to the Thai Ministry of Public Health (incidence of 3.27/100,000 persons), but the proportion that were MSM was not known, nor the proportion that were HIV-infected.[19]

The factors involved with high prevalence of other STIs among MSM have not been well documented in Asia (including Thailand), although associations with HIV infection have been found in cross-sectional studies and convenience samples.[20] In addition, risk factors for STIs in MSM in the west have recently been shifting towards a greater role of the Internet, use of club drugs and male sex work.[21,22] Although risk factors for HIV prevalence and incidence among MSM in Thailand have been studied,[23,24] information about risk factors associated with ulcerative STIs including syphilis and HSV-2 in this group has yet to be reported.

In 2006 we began an observational, prospective cohort study among Thai MSM in Bangkok, based at the Silom Community Clinic, an HIV testing and research centre for MSM.[23] The goals of the study were to determine HIV and STI baseline prevalence and incidence, examine changes in sexual behavioural patterns and determine willingness to participate in biomedical HIV prevention trials. The aim of this paper is to report TP and HSV-2 seropositivity and risk factors associated with the prevalence, by using baseline data, in this cohort.

METHODS

Study population

Eligible for participation in the MSM cohort were men aged 18 years or older who were Thai national, resident of the Bangkok metropolitan area or peripheral provinces (Samut Prakarn, Chachoensao, Pathumthani, Nonthaburi, Nakorn Pathom and Samut Sakorn), had penetrative oral or anal sex with another man in the past six months, and were available for four-monthly follow-up visits for a minimum of three years. Men were recruited from a variety of sources, including HIV voluntary counselling and testing services provided at the study clinic, at venues where MSM congregate for socializing and seeking sexual partners, the Internet, referral by community-based organizations (Rainbow Sky Association, Bangkok Rainbow Organization, Sex Worker in Group and Poz Home Center) and word of mouth.

Data collection

Demographic and behavioural data were collected using audio computer-assisted self-interview at the enrollment (baseline) visit. Subsequently, an optional medical history and a general physical examination were performed, and a comprehensive clinical exam to detect any genital and anorectal STIs, and a 25-mL blood sample collection was performed by a well-trained study nurse.

HSV-2 serostatus was determined by detecting anti-HSV-2 human immunoglobulin G (IgG) antibodies by enzyme-linked immunosorbent assay (ELISA). Stored plasma samples were tested using the HerpeSelect® 2 ELISA IgG (Focus Diagnostics, Cypress, CA, USA), with an index cut-off threshold of 1.1 according to the package insert.

TP seropositivity was determined according to the following algorithm. All participants were screened with a rapid plasma reagin (non-treponemal) assay (Macro-Vue™ RPR 18 mm Circle Card Test; Becton Dickinson Microbiology Systems, Sparks, MD, USA). In rapid plasma reagin (RPR)-reactive (any titre) participants, anti-TP antibodies were determined by immunochromatography (IC) assay (Determine™ Syphilis TP; Inverness Medical Japan, Chiba, Japan). A positive IC antibody test and reactive RPR reagin test $\geq$1:8 was interpreted as being seropositive for TP (i.e. evidence of current or past syphilis infection). We defined persons with RPR titres lower than 1:8,[25] negative IC antibody test and no symptoms or signs of prior infection as indeterminate and excluded them from prevalence calculations and further analysis (clinically they were treated).[26]

Men were tested for HIV infection at baseline using OraQuick (OraSure Technologies Inc, Beaverton, OR, USA) on oral fluid, and if reactive, confirmed with three rapid tests on blood (Determine™ HIV 1/2, Inverness Medical Japan, Chiba, Japan; DoubleCheck™ II HIV 1&2, Organics Ltd, Inverness Medical Innovations, Yavne, Israel; Capillus™ HIV-1/HIV-2, Trinity Biotech, Jamestown, NY, USA [after November 2008 replaced by Core™ HIV1/2, Birmingham, UK]). Persons with a negative oral fluid OraQuick were considered to be HIV-negative. A positive Determine was confirmed with DoubleCheck and Capillus. Participants with positive results on all three confirmatory blood tests were considered to be HIV-positive. Participants with any discordant results between the three confirmatory tests were considered inconclusive, and re-tested at two weeks. Participants remaining inconclusive at two weeks were retested at four weeks by ELISA, and if negative, were considered to be negative. Those with positive ELISA results at four weeks received confirmatory testing with two additional blood tests.

Data analysis

We determined the prevalence of TP and HSV-2 seropositivity, and HIV infection by dividing the number of men with confirmed positive tests by the total number of men tested in the study, multiplied by 100. Bivariate risk factors associated with TP and HSV-2 seropositivity were evaluated using odds ratios (OR) and 95% confidence intervals (CI); OR were considered statistically significant if the CI did not include 1.0 as a possible value. Pearson correlation was used to assess multicollinearity among variables. When the correlation between two variables was moderate to high ($r \geq 0.30$), only one variable was entered into the logistic regression model. Variables with $P \leq 0.10$ in bivariate analyses or substantive importance were further entered in multivariable backward stepwise logistic regression analyses to identify independent risk factors for prevalent TP seropositivity and HSV-2 infection. Adjusted OR (AOR) were estimated from the predicted marginal means (STATA/SE 11.0 for Windows; StataCorp, College Station, TX, USA). We eliminated variables contributing to the predictiveness of the model based on a significant threshold at $P < 0.05$ (two-tailed), to arrive at a final multivariable model.

Human subjects review

The protocol of this study was reviewed and approved by the Ethical Review Committee for Research in Human Subjects of

the Thailand Ministry of Public Health and by an Institutional Review Board of the US Centers for Disease Control and Prevention. Prior to enrollment in the study, written informed consent was obtained from all study participants. Participants who tested positive for HIV infection were referred for antimicrobial prophylaxis and antiretroviral treatment according to the national Thai guideline.

RESULTS

Demographic and behavioural characteristics at baseline

Between April 2006 and March 2010, 1740 men were screened for enrollment, of whom 1559 (89.6%) were eligible and 1544 (88.7%) were enrolled in the study. Reasons for non-enrollment included inability to follow up consistently for three months, no recent sexual activity, age <18 years old and home location out of the city. Of 1544 men enrolled, three persons were identified as testing indeterminate for TP (RPR titre 0–1:8 and negative IC) and excluded. Therefore, 1541 who had TP and HSV-2 data available were included in this analysis. Demographic and behavioural characteristics of the cohort at baseline are shown in Table 1, available online only at: http://www.ijsa.rsmjournals.com/cgi/content/full/23/6/424/DC1. Among all, 1109 (72.0%) were younger than 30 years old at baseline, and 754 (48.9%) had ever been tested for HIV infection. In total, 333 (21.6%) persons tested positive for HIV antibody by all confirmatory tests at baseline.

Prevalence and characteristics of TP seropositivity

In our study population, 68 (4.4%) tested positive for past or current TP infection using RPR and the IC assay (Table 1). Among these 68 persons, the median age was 26.5 years (range 19–44 years), and 12 (17.7%) were 21 years or younger; 53 (77.9%) had a high school education or higher. Per report, 18/68 (26.5%) reported having had a genital ulcer before; 3/68 (4.4%) reported a current genital ulcer; 38/68 (55.9%) reported having been diagnosed with an STI before; and 15/68 (22.1%) reported having been diagnosed with syphilis and receiving treatment.

The distribution of RPR between the 15 men with a history of syphilis, and the 53 men reporting no history of syphilis were as follows: eight (53.3%) of the men with a history of syphilis had a titre <1:8, four (26.7%) had an RPR titre of 1:8 and three (20.0%) had a titre >1:8. Among the 53 men without a history, 26 (49.1%) had a titre <1:8, and four (7.5%) had a titre of 1:8. The remaining 23 (43.4%) had a titre >1:8. The median titre among those with a history of syphilis was 1:2, and the median titre among those without a history was 1:8.

Among the 68 TP seropositives, 20 (29.4%) reported using drugs to increase sexual pleasure, and 58 (85.3%) reported having had receptive anal sex in the past four months. Among 57 reporting a casual male partner, 30 (52.6%) men reported always using condoms over the past four months and 32 (56.1%) reported ever having sex with a casual male partner in a sauna. Among the 66 reporting recent partners (steady, casual and commercial), the median number of male partners over the past four months was seven. Among the total 68 TP seropositive individuals, 37 (54.4%) reported ever having had group sex on at least one prior occasion. Thirty-four (50%) had had at least one prior HIV test, and 32 (47.1%) tested positive for HIV infection at baseline; 16/68 (23.5%) reported having had non-Asian partners, and 52 (76.5%) reported only Asian partners.

In bivariate analysis, TP seropositivity was most strongly associated with having less than high school education (OR 3.45, 95% CI 1.71–6.94), having sex with a casual partner in the park (OR 2.71, 95% CI 1.41–5.19), and having six or more casual male partners in the past four months (OR 2.67, 95% CI 1.30–5.49) (Table 1). Other statistically significant risk factors included living alone, reporting ever using nitrate inhalants for enhancement, reporting ever using drugs to increase sexual pleasure, paying money (or gifts or favours) for sex in the past four months, receiving money (or gifts or favours) for sex in the past four months and reporting ever having had group sex. Of laboratory markers, evidence of HIV-1 seropositivity (OR 3.46, 95% CI 2.11–5.67) and HSV-2 seropositivity (OR 4.17, 95% CI 2.55–6.82) at baseline were significantly associated with TP seropositivity.

In multivariable analysis, independent risk factors associated with prevalent TP seropositivity were reporting participating in group sex (AOR 1.87, 95% CI 1.07–3.28), reporting paying for sex (AOR 2.10, 95% CI 1.15–3.83), reporting sex with a casual partner in a park (AOR 2.00, 95% CI 1.01–3.95) and being HSV-2 seropositive (AOR 3.54, 95% CI 2.05–6.13) (Table 1).

Prevalence and characteristics of HSV-2 infection

Baseline HSV-2 antibody was detected in 319 (20.7%) persons in the cohort (Table 2, available online only at: http://www.ijsa.rsmjournals.com/cgi/content/full/23/6/424/DC1). Among these 319 persons, the median age was 28 years (range 18–56 years), and 41 (12.9%) were 21 years or younger. Of the total, 296 (92.8%) reported never being married, and 256 (80.3%) had a high school education or higher. Two hundred and fifteen (67.4%) reported having had receptive anal sex in the past four months, and two (0.6%) reported never having anal sex; 130 (40.8%) reported ever having had group sex. Among the 245 reporting a recent casual partner over the past four months, 139 (56.7%) reported always using condoms with a casual sexual partner. The median number of male partners (steady, casual and commercial) over the past four months was 5. Half (50.5%) of the 319 persons with evidence of HSV-2 infection ever had an HIV test, and 134 (42.0%) were HIV-infected at baseline; 260/319 (81.5%) reported having had non-Asian partners and 59 (18.5%) reported only Asian partners. Other demographic and behavioural characteristics are presented in Table 2.

In bivariate analysis, HSV-2 infection at baseline was associated with age ≥30 years (OR 2.74, 95% CI 1.86–4.03), having less than a high school education (OR 2.83, 95% CI 1.95–4.11), unemployment or study only (OR 0.60, 95% CI 0.44–0.83), living alone (OR 1.44, 95% CI 1.09–1.91) and reporting ever being married (OR 2.99, 95% CI 1.72–5.20) (Table 2). Other significant risk factors associated with HSV-2 infection included use of drugs in the past; use of nitrates, methamphetamine and club drugs to increase sexual pleasure; meeting casual sexual partners in a sauna, department store, park and hotel; reporting receiving money for sex; and reporting having group sex. Of laboratory markers, evidence of HIV-1 seropositivity (OR 3.72, 95% CI 2.84–4.87) and TP seropositivity (OR 4.17, 95% CI 2.55–6.82) at baseline were significantly associated with prevalent HSV-2 infection.

In multivariable analysis, independent risk factors associated with prevalent HSV-2 infection were age 30 years or older (AOR 3.30, 95% CI 2.02–5.37), having less than a high school education (AOR 3.60, 95% CI 2.24–5.78), past use of drugs (AOR 1.47, 95% CI 1.09–1.98), meeting casual sexual partners at a public venue (sauna) (AOR 1.40, 95% CI 1.03–1.89) and TP seropositivity (AOR 3.38, 95% CI 1.91–6.01) (Table 2).

DISCUSSION

In our study of the prevalence of antibodies to two important ulcerative STIs among a cohort of MSM in Bangkok, we found a 4.4% prevalence of TP seropositivity and a 20.7% prevalence of HSV-2 infection. These data suggest that infections with these two STIs, which frequently cause ulcerative genital lesions, are not uncommon in this population. A TP seropositivity prevalence of 4.4% is consistent with that found in MSM populations in other locations[27] but less than in the reports coming from the regional neighbour China (15–25%).[28–32] The lower serology titres among those reporting a history of syphilis (1:2 versus 1:8) are more likely the result of old treated syphilis rather than newly acquired ones. In our study the strongest bivariate risk factors associated with TP seropositivity were less education and markers of risky sex. The association with less education is notable, and contrary to what is being found in other Asian urban areas, but similar to risk factors found in some European cities.[33] Younger people may have a higher risk profile in general (high HIV prevalence sexual network) and may therefore be also at higher risk of STIs, but this was not seen.

In addition, our bivariate analysis raises the question whether using drugs to enhance sexual pleasure may be associated with risky sex behaviour (with increased intensity and longer duration and thus higher exposure, as well as higher partner change, for instance during group sex), and greater risk of TP seropositivity, especially if HIV infected. This has not been well documented in the literature, nor proven in this study. However, in our multivariate analysis several sexual risk characteristics were associated, including group sex and money/gift exchange for sex, which have been shown as risk factors in other studies among MSM in Asia.[34,35]

Our baseline study documents that HSV-2 infection is a common STI among MSM in Bangkok. The prevalence is similar to that observed in many population-based prevalence studies around the world,[36] as well as in specific marginalized populations.[37,38] However, no general population-based data exist in Thailand with which to make a comparison. Surveillance of HSV-2 prevalence and of reports of new cases among MSM is important, since HSV-2 infection often precedes HIV infection and a risk factor for HIV acquisition among MSM.[39] In our final multivariate model, we found older age, lower education, past use of drugs, and having casual sexual partners in a public venue (sauna) to be risk factors for HSV-2 infection. Public venues are of great concern, as they are places where high-risk sex occurs. These associations are consistent with those found in other studies among MSM.[37,40] Reporting past sexual contact with non-Asian partners was not uncommon, and reflects the growing global connectedness of the MSM community.

There are several limitations to note in our study. First of all, men in this study were not a random sample of MSM in Bangkok. We recognize that risk behaviours and STI and HIV prevalence may be different in the MSM community at large. We have no current measure as to the representativeness of our MSM cohort to the larger MSM population in the city of Bangkok. Secondly, our study is limited to an analysis of serological reactivity to TP and HSV-2, i.e. possible current clinical HSV-2 disease or syphilis but also past syphilis exposure. Third, our data are cross-sectional and therefore do not allow any causal inferences, e.g. it is unknown whether HSV-2 infection occurred before or after HIV infection was acquired. Analysis of prospective data is planned to determine incident infection. Lastly, we do not have any data on drug use in the sexual partners of these men; for example, the index case might not use drugs but their partner might take methamphetamine, and this potential increase in risk is not captured by individual data. If both partners use drugs, there may be additive or multiplicative risk that is also not captured.

In conclusion, the prevalence of TP seropositivity and HSV-2 infection we found among a cohort of MSM in Bangkok underscores the need for innovative measures and increased efforts to prevent STIs in this population. Prevention efforts aimed at decreasing drug use may help. Our findings can be used locally for advocacy to increase attention and to curb the emerging epidemic of syphilis among MSM in Thailand. Public health services need to improve targeted programming aimed at reaching younger MSM, less educated MSM and those with STIs. Culturally tailored safer sex and STI educational messages targeting younger MSM, less educated MSM and MSM with STIs, in combination with provision of condoms and water-based lubricants, should be a top priority. Given that tenofovir gel has been shown to reduce vaginal HIV acquisition[7] and HSV-2 acquisition in women, future efficacy studies of antiretroviral-based microbicides should also include MSM to assess whether similar reductions can be found regarding rectal acquisition of HIV and HSV-2.

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Author contributions: TH and FvG conceived the study. FvG oversaw study implementation and drafted the manuscript with TH. WT, WW and PM oversaw data collection, performed data management and statistical analysis. JM and WC oversaw and performed laboratory testing. SC and AV were responsible for study implementation and clinical data collection. All authors reviewed and edited the manuscript.

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Table 1 **Baseline demographic and behavioural characteristics among all study participants, baseline *Treponema pallidum* (TP) positivity by RPR and immunochromatography in a cohort of men who have sex with men in Bangkok, Thailand, 2006–2009 (*N* = 1541*)**

		Baseline TP			
Baseline characteristic	**Total *n* (col%)**	**Seropositive, *n* (row%)**	**Seronegative, *n* (row%)**	**Bivariate, OR (95% CI)**	**Multivariable, AOR (95% CI)**
Overall	1541 (100)	68 (4.4)	1473 (95.6)		
Age group (years)					
≥30	432 (28.0)	22 (5.1)	410 (94.9)	1.20 (0.58–2.46)	–
22–29	829 (53.8)	34 (4.1)	795 (95.9)	0.96 (0.49–1.87)	
18–21	280 (18.2)	12 (4.3)	268 (95.7)	1	
Education					
Less than high school	163 (10.5)	15 (9.2)	148 (90.8)	3.45 (1.71–6.94)	NS
High school or equivalent	713 (46.3)	34 (4.8)	679 (95.2)	1.70 (0.96–3.02)	
University and above	665 (43.2)	19 (2.9)	646 (97.1)	1	
Employment					
Study only/none	356 (23.1)	16 (4.5)	340 (95.5)	1.03 (0.58–1.82)	–
Working (and study)	1185 (76.9)	52 (4.4)	1133 (95.6)	1	
Current living situation					
Alone, roommate	730 (47.4)	41 (5.6)	689 (94.4)	1.87 (1.06–3.30)	NS
Live with partner	226 (14.7)	9 (4.0)	217 (96.0)	1.31 (0.58–2.95)	
Live with family	585 (38.0)	18 (3.1)	567 (96.9)	1	
Marital status					
Married/ever married	54 (3.5)	3 (5.6)	51 (94.4)	1.29 (0.39–4.23)	–
Single	1487 (96.5)	65 (4.4)	1422 (95.6)	1	
Inhaled nitrates (poppers) (past four months)					
Yes	166 (10.8)	12 (7.2)	154 (92.8)	1.84 (0.96–3.50)	–
No	1375 (89.2)	56 (4.1)	1319 (95.9)	1	
Used drugs to increase sexual pleasure (ever) †					
Yes	261 (16.9)	20 (7.7)	241 (92.3)	2.13 (1.24–3.65)	NS
No	1280 (83.1)	48 (3.8)	1232 (96.2)	1	
Inhaled nitrates (poppers) to enhance sex (ever)					
Yes	214 (13.9)	15 (7.0)	199 (93.0)	1.81 (1.002–3.28)	–
No	1327 (86.1)	53 (4.0)	1274 (96.0)	1	
Anal sex position with men (past four months)					
Receptive only or both	1226 (79.6)	58 (4.7)	1168 (95.3)	1.24 (0.17–9.32)	–
Insertive only	289 (18.7)	9 (3.1)	280 (96.9)	0.80 (0.10–6.60)	
No anal sex	26 (1.7)	1 (3.9)	25 (96.1)	1	
Total number of casual male partners (past four months)					
≥6	365 (23.7)	26 (7.1)	339 (92.9)	2.67 (1.30–5.49)	NS
1–5	782 (50.7)	31 (4.0)	751 (96.0)	1.44 (0.72–2.89)	
0	394 (25.6)	11 (2.8)	383 (97.2)	1	
Condom use with casual male partners (past four months)					
Not always	438 (28.4)	27 (6.2)	411 (93.8)	1.49 (0.87–2.54)	–
Always	709 (46.0)	30 (4.2)	679 (95.8)	1	
No anal sexual partner	394 (25.6)	11 (2.8)	383 (97.2)	–	
Had sex with casual partner at sauna (*n* = 1165)					
Yes	559 (48.0)	32 (5.7)	527 (94.3)	1.41 (0.83–2.41)	–
No	606 (52.0)	25 (4.1)	581 (95.9)	1	
Had sex with casual partner at park (*n* = 1165)					
Yes	122 (10.5)	13 (10.7)	109 (89.3)	2.71 (1.41–5.19)	2.00 (1.01–3.95)
No	1043 (89.5)	44 (4.2)	999 (95.8)	1	1
Paid money for sex (past four months)					
Yes	230 (14.9)	19 (8.3)	211 (91.7)	2.32 (1.34–4.02)	2.10 (1.15–3.83)
No	1311 (85.1)	49 (3.7)	1262 (96.3)	1	1
Receive money for sex (past four months)					
Yes	302 (19.6)	24 (8.0)	278 (92.0)	2.35 (1.40–3.92)	NS
No	1239 (80.4)	44 (3.6)	1195 (96.4)	1	
Group sex (ever)					
Yes	549 (35.6)	37 (6.7)	512 (93.3)	2.24 (1.37–3.65)	1.87 (1.07–3.28)
No	992 (64.4)	31 (3.1)	961 (96.9)	1	1
Ever had HIV test					
Yes	754 (48.9)	34 (4.5)	720 (95.5)	1.05 (0.64–1.70)	–
No	787 (51.1)	34 (4.3)	753 (96.7)	1	
HIV-1 result					
Positive	333 (21.6)	32 (9.6)	301 (90.4)	3.46 (2.11–5.67)	–
Negative	1208 (78.4)	36 (3.0)	1172 (97.0)	1	
HSV-2 result					
Positive	319 (20.7)	34 (10.7)	285 (89.3)	4.17 (2.55–6.82)	3.54 (2.05–6.13)
Negative	1222 (79.3)	34 (2.8)	1188 (97.2)	1	1

RPR = rapid plasma region; OR = odds ratio; AOR = adjusted odds ratio; CI = confidence interval; NS = not significant, variable was eliminated during backwards stepwise regression and not included in the final model

*Three persons with indeterminate results are excluded from analysis; †Ever used at baseline, use during past four months during follow up

Table 2 **Baseline demographic and behavioural characteristics among all study participants, baseline HSV-2 positive serologies in a cohort of men who have sex with men in Bangkok, Thailand, 2006–2009**

Baseline characteristic	Total *n* (col%)	HSV-2 Seropositive, *n* (row%)	HSV-2 Seronegative, *n* (row%)	Bivariate, OR (95% CI)	Multivariate, AOR (95% CI)
Overall	1541 (100)	319 (20.7)	1222 (79.3)		
Age group (years)					
≥30	432 (28.0)	138 (31.9)	294 (68.1)	2.74 (1.86–4.03)	3.30 (2.02–5.37)
22–29	829 (53.8)	140 (16.9)	689 (83.1)	1.18 (0.81–1.73)	1.31 (0.83–2.07)
18–21	280 (18.2)	41 (14.6)	239 (85.4)	1	1
Education					
Less than high school	163 (10.6)	63 (38.7)	100 (61.3)	2.83 (1.95–4.11)	3.60 (2.24–5.78)
High school or equivalent	713 (46.3)	135 (18.9)	578 (81.1)	1.05 (0.80–1.38)	1.48 (1.05–2.08)
University and above	665 (43.2)	121 (18.2)	544 (81.8)	1	1
Employment					
Study only/none	356 (23.1)	53 (14.9)	303 (85.1)	0.60 (0.44–0.83)	–
Working (+study)	1185 (76.9)	266 (22.5)	919 (77.5)	1	
Current living situation					
Alone, roommate	730 (47.4)	161 (22.1)	569 (77.9)	1.44 (1.09–1.91)	NS
Live with partner	226 (14.7)	62 (27.4)	164 (72.6)	1.93 (1.34–2.77)	
Live with family	585 (38.0)	96 (16.4)	489 (83.6)	1	
Marital status					
Married/ever married	54 (3.5)	23 (42.6)	31 (57.4)	2.99 (1.72–5.20)	NS
Single	1487 (96.5)	296 (19.9)	1191 (80.1)	1	
Use of any drugs (ever)					
Yes	602 (39.1)	152 (25.3)	450 (74.7)	1.56 (1.22–2.00)	1.47 (1.09–1.98)
No	939 (60.9)	167 (17.8)	772 (82.2)	1	1
Inhaled nitrates (poppers) (past four months)					
Yes	166 (10.8)	49 (29.5)	117 (70.5)	1.71 (1.20–2.45)	–
No	1375 (89.2)	270 (19.6)	1105 (80.4)	1	
Use of meth to enhance sex (ever)					
Yes	52 (3.4)	18 (34.6)	34 (65.4)	2.09 (1.16–3.75)	NS
No	1489 (96.6)	301 (20.2)	1188 (79.8)	1	
Inhaled nitrates (poppers) to enhance sex (ever)					
Yes	214 (13.9)	59 (27.6)	155 (72.4)	1.56 (1.12–2.17)	NS
No	1327 (86.1)	260 (19.6)	1067 (80.4)	1	
Use of club drugs to enhance sex[†] (ever)					
Yes	100 (6.5)	32 (32.0)	68 (68.0)	1.89 (1.21–2.94)	NS
No	1441 (93.5)	287 (19.9)	1154 (80.1)	1	
Used Viagra (ever)					
Yes	155 (10.1)	40 (25.8)	115 (74.2)	1.38 (0.94–2.02)	–
No	1386 (89.9)	279 (20.1)	1107 (79.9)	1	
Usual anal sex position with men					
Receptive only or both	982 (63.7)	215 (21.9)	767 (78.1)	3.36 (0.79–14.35)	–
Insertive only	533 (34.6)	102 (19.1)	431 (80.9)	2.84 (0.66–12.21)	
No anal sex	26 (1.7)	2 (7.7)	24 (92.3)	1	
Total number of casual male partners (past four months)					
≥6	365 (23.7)	79 (21.6)	286 (78.4)	1.19 (0.84–1.70)	–
1–5	782 (50.7)	166 (21.2)	616 (78.8)	1.17 (0.86–1.58)	
0	394 (25.6)	74 (18.8)	320 (81.2)	1	
Condom use with casual male partner (past four months)					
Not always	438 (38.2)	106 (24.2)	332 (75.8)	1.38 (0.99–1.92)	NS
Always	709 (61.8)	139 (19.6)	570 (80.4)	1.05 (0.77–1.44)	
No anal sexual partner	394 (25.6)	74 (18.8)	320 (81.2)	1	
Met casual partners on Internet (*n* = 1165)					
Yes	541 (46.4)	99 (18.3)	442 (81.7)	0.71 (0.53–0.94)	NS
No	624 (53.6)	150 (24.0)	474 (76.0)	1	
Met casual partners at sauna (*n* = 1165)					
Yes	606 (52.0)	150 (24.8)	456 (75.2)	1.53 (1.15–2.03)	1.40 (1.03–1.89)
No	559 (48.0)	99 (17.7)	460 (82.3)	1	1
Met casual partners at department store (*n* = 1165)					
Yes	236 (20.3)	71 (30.1)	165 (69.9)	1.82 (1.31–2.51)	NS
No	929 (79.7)	178 (19.2)	751 (80.8)	1	
Met casual partners at park (*n* = 1165)					
Yes	219 (18.8)	64 (29.2)	155 (70.8)	1.70 (1.22–2.37)	NS
No	946 (81.2)	185 (19.6)	761 (80.4)	1	
Had sex with casual partner at hotel (*n* = 1165)					
Yes	364 (31.2)	92 (25.3)	272 (74.7)	1.39 (1.03–1.86)	NS
No	801 (68.8)	157 (19.6)	644 (80.4)	1	
Had sex with casual partner at park (*n* = 1165)					
Yes	122 (10.5)	34 (27.9)	88 (72.1)	1.49 (0.97–2.27)	–
No	1043 (89.5)	215 (20.6)	828 (79.4)	1	

(Continued)

Table 2 **Continued**

Baseline characteristic	Total *n* (col%)	HSV-2 Seropositive, *n* (row%)	HSV-2 Seronegative, *n* (row%)	Bivariate, OR (95% CI)	Multivariate, AOR (95% CI)
Paid money for sex (past four months)					
Yes	230 (14.9)	58 (25.2)	172 (74.8)	1.36 (0.98–1.88)	–
No	1311 (85.1)	261 (19.9)	1050 (80.1)	1	
Received money for sex (past four months)					
Yes	302 (19.6)	83 (27.5)	219 (72.5)	1.61 (1.21–2.15)	NS
No	1239 (80.4)	236 (19.1)	1003 (80.9)	1	
Group sex (ever)					
Yes	549 (35.6)	130 (23.7)	419 (76.3)	1.32 (1.02–1.70)	NS
No	992 (64.4)	189 (19.1)	803 (80.9)	1	
Ever had HIV test					
Yes	754 (48.9)	161 (21.4)	593 (78.6)	1.08 (0.87–1.38)	–
No	787 (51.1)	158 (20.1)	629 (79.9)	1	
HIV-1 result					
Positive	333 (21.6)	134 (40.2)	199 (59.8)	3.72 (2.84–4.87)	–
Negative	1208 (78.4)	185 (15.3)	1023 (84.7)	1	
TP					
Positive	68 (4.4)	34 (50.0)	34 (50.0)	4.17 (2.55–6.82)	3.38 (1.91–6.01)
Negative	1473 (95.6)	285 (19.4)	1188 (80.6)	1	1

HSV-2 = herpes simplex virus type 2; TP = *Treponema pallidum*; OR = odds ratio; AOR = adjusted odds ratio; CI = confidence interval; NS = not significant, variable was eliminated during backwards stepwise regression and not included in the final model

*Ever used at baseline, use during past four months during follow-up

†Club drugs: cannabis, ecstasy (MDMA), amphetamine, methamphetamine (meth), ketamine, cocaine and gammahydroxybutyrate