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Incidence and risk factors for urethral and anal gonorrhoea and chlamydia in a cohort of HIV-negative homosexual men: the Health in Men Study

F Jin, G P Prestage, L Mao, S C Kippax, C M Pell, B Donovan, P H Cunningham, D J Templeton, J M Kaldor, A E Grulich

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See end of article for authors' affiliations

Correspondence to: Fengyi Jin, National Centre in HIV Epidemiology and Clinical Research, Level 2, 376 Victoria Street, Darlinghurst, NSW 2010, Australia; jjin@nchecr.unsw.edu.au

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Background: Early detection and treatment of bacterial sexually transmitted infections has been advocated as an HIV prevention strategy.
Aim: To inform screening guidelines, the incidence and risk factors for urethral and anal gonorrhoea and chlamydia were studied in a prospective cohort of community-based HIV negative homosexual men in Sydney, New South Wales, Australia.
Methods: All participants were offered annual screening for gonorrhoea and chlamydia (study-visit diagnoses) on urine and anal swabs using nucleic acid amplification. Participants also reported diagnoses of gonorrhoea and chlamydia made elsewhere between interviews (interval diagnoses). All diagnoses were summed to create a combined incidence rate, and detailed data on specific sexual practices with casual and regular partners were collected.
Results: Among 1427 men enrolled, the combined incidence rates were 3.49 and 2.96 per 100 person-years for urethral and anal gonorrhoea, respectively; and 7.43 and 4.98 per 100 person-years for urethral and anal chlamydia, respectively. Urethral infections were associated with unprotected anal intercourse (UAI) with HIV-positive partners (hazard ratio (HR) = 2.58, 95% CI 1.10 to 6.05 for urethral gonorrhoea) and with frequent insertive oral sex (p for trend 0.007 for urethral chlamydia). Anal infections were associated with receptive UAI (p for trend 0.001 for both anal gonorrhoea and chlamydia) and other receptive anal sexual practices. Stratified analyses showed the independence of the associations of insertive oral sex with urethral infections and of non-intercourse receptive anal practices with anal infections.
Conclusion: Incident gonorrhoea and chlamydia were common. Risk behaviours for both urethral and anal infections were not restricted to UAI. Screening that includes tests for anal and urethral infections should be considered for all sexually active homosexual men, not just for those who report UAI.

In industrialised countries, the incidence of gonorrhoea in homosexual men rapidly declined after the onset of the HIV epidemic.[1 2] However, rates have increased since the mid-1990s in many settings including Australia.[3–7] Concurrently, there has been a steady increase in rates of chlamydia, which has become the most common notifiable infectious disease in Australia.[8] In response to the increasing rates of these infections, screening guidelines have been released in some industrialised countries, including Australia and the US.[9 10] These guidelines suggest that homosexually active men should be tested at least annually for gonorrhoea and chlamydia. US guidelines published by the Centers for Disease Control and Prevention and others recommend anal testing only in those who report receptive anal sex,[10 11] but there is an almost complete lack of prospective data on risk factors for these infections in homosexual men.

Early detection and treatment of curable anal and urethral sexually transmitted infections (STIs) has been suggested as a possible strategy for HIV prevention in homosexual men.[12] This approach is likely to be particularly important for anal STIs, as most HIV infections in homosexual men occur as a result of receptive anal intercourse.[13] We studied the incidence and risk factors for urethral and anal gonorrhoea and chlamydia in a community-based cohort of HIV-negative homosexual men in Sydney to inform current STI screening guidelines.

METHODS

Participants

Participants were HIV-negative men in the Health in Men (HIM) Cohort Study, recruited from community-based sources from June 2001 to December 2004. The methods of the HIM Study have been described in detail previously.[14] Briefly, men eligible for HIM met the following criteria:

1. They reported having sex with other men in the previous 5 years
2. They lived in Sydney or participated regularly in the homosexual community of Sydney
3. They tested HIV negative at baseline.

Signed informed consent was obtained from all participants. The study was approved by the Human Research Ethics Committee of the University of New South Wales, Sydney, New South Wales, Australia.

Data collection

All eligible men willing to participate underwent annual face-to-face interviews, in addition to 6-monthly telephone interviews. The questionnaire included demographic factors and detailed sexual behaviours in the past 6 months. For unprotected anal intercourse (UAI), we collected data separately for regular and for casual partners by participant-reported HIV status of these partners (negative, positive or unknown); and for receptive intercourse by whether or not ejaculation had occurred.

Abbreviations: HIM, Health in Men; NAAT, nucleic acid amplification testing; SDA, strand displacement amplification; STI, sexually transmitted infection; UAI, unprotected anal intercourse

In addition to annual testing as part of this study, we asked participants to report if they had been diagnosed with gonorrhoea or chlamydia in the urethra or anus between annual visits and in the 12-month period before the baseline interview.

Laboratory studies

Although the cohort study started in June 2001, nucleic acid amplification testing (NAAT) for gonorrhoea and chlamydia was not introduced to the HIM Study until January 2003. Apart from consent, no additional criteria were required for participation in this testing. Participants who consented to the testing collected a first-catch urine sample and a self-collected anal swab at the time of each annual visit.[15] They were instructed to insert a moistened Dacron swab 3–5 cm into their anus and rotate the swab gently. Urine samples and anal swabs were processed and tested for gonorrhoea and chlamydia by strand displacement amplification (SDA) using the BD ProbeTec assay (BD Diagnostics, Sparks, Maryland, USA) as per the manufacturer's instructions.

As the BD SDA test for gonorrhoea infection is not cleared by the US Food and Drug Administration for anal specimens, and commensal *Neisseria* infections are common in the gastrointestinal tract, positive anal swabs for gonorrhoea were stored and later tested by another NAAT (NGpapLC), targeting a different gene (*N gonorrhoeae* porA pseudo gene),[16] to confirm the diagnosis.

Incidence definition

Participants who reported a diagnosis of gonorrhoea or chlamydia in the past 12 months were treated as self-reported incident cases (interval diagnoses). As participants reported a 12-month history of diagnosis at baseline, 1 person-year was allocated for all participants who responded to the question at baseline interview, whether or not they reported infection.

Participants who tested positive to gonorrhoea or chlamydia at annual visits were treated as NAAT-confirmed incident cases (study-visit diagnoses). To incorporate data from the first test for incidence analyses, 1 person-year was allocated for participants' initial tests, whether they tested positive or negative.

To assess whether the inclusion of baseline data for incidence calculations led to bias, we compared incidence rates and major risk factors, with and without the inclusion of the baseline data. Results using either method were similar, but the inclusion of baseline data enabled a considerable increase in precision (see additional tables A–F available online at http://sti.bmj.com/supplemental).

Participants who reported a diagnosis of gonorrhoea or chlamydia or tested positive to such conditions were treated as combined incident cases. We excluded diagnoses made at the previous annual visit for the HIM Study from the definition of interval diagnoses. This combined calculation was applicable only from January 2003, the start of NAAT in the study.

Statistical analysis

Data collected until the end of 2005 were statistically analysed using Stata V.8.2. (The exact binomial method was used to calculate 95% confidence intervals (CIs)). For the calculation of incidence, the midpoint between interviews was used as the date of infection for participants who had an interval or study-visit diagnosis. We permitted multiple failures in the subsequent study visits in the calculation of incidence.

On the basis of combined incidence, we estimated associations with hypothesised risk factors for the occurrence of gonorrhoea and chlamydia. In univariate analyses, we examined the association with a broad range of sexual behaviours with regular and casual partners, including protected anal intercourse and UAI, other anal practices and oral sex. For ordinal variables, such as age groups, number of partners and frequencies of certain sexual behaviours, we report p values for trend. As results for the association of anal and urethral gonorrhoea and chlamydia with sexual behaviours with regular partners were similar to the results for those with casual partners, the results for behaviours with regular partners are not presented here.

We used multivariate Cox's regression models allowing for multiple failures to determine risk factors that were independently associated with incident infections.[17] In the multivariate analyses we considered variables with $p<0.1$ in univariate analyses. In multivariate analyses, we considered sexual behaviour variables that could have led to exposure of the urethra or anus (as appropriate). For urethral infections, we considered insertive anal intercourse and insertive oral sex. For anal infections, we considered receptive anal intercourse and other receptive anal practices, including with a finger (fingering), fist (fisting), tongue (rimming) or a dildo.

To further exclude the possibility of confounding by UAI, stratified analyses of risk for each infection were conducted among those who did not report receptive or insertive UAI.

RESULTS

During the course of the study, we enrolled 1427 participants. The median age at enrolment was 35 years, ranging from 18 to 75 years. Most (95.2%) of participants self-identified as gay or homosexual. By the end of 2005, 1245 (87.2%) men had completed at least one follow-up face-to-face interview. The median follow-up time was 2.29 years.

NAATs were carried out at a total of 2877 visits (88.6% of visits from January 2003). Overall, 32 participants screened positive for anal gonorrhoea on BD SDA, and positive swabs were stored on 20 (62.5%) of them. Of the stored swabs, 17 (85.0%) were confirmed using the NGpapLC method. Given the high confirmatory rate, we assumed that the 12 patients without stored swabs were truly infected.

Baseline findings

At baseline, 5.51% (95% CI 4.34% to 6.87%) of the men reported a diagnosis of urethral gonorrhoea and 1.97% (95% CI 1.29% to 2.87%) reported a diagnosis of anal gonorrhoea in the past 12 months. At initial test ($n = 1210$), the prevalence values of urethral and anal gonorrhoea were 0.33% (95% CI 0.09% to 0.85%) and 0.91% (95% CI 0.46% to 1.63%), respectively. For urethral and anal chlamydia, the baseline interval diagnosis rates were 8.67% (95% CI 7.21% to 10.31%) and 1.96% (95% CI 0.94% to 3.57%), respectively. The prevalence values of urethral and anal chlamydia at baseline testing were 0.92% (95% CI 0.46% to 1.64%) and 4.36% (95% CI 3.27% to 5.68%), respectively.

Incidence

Table 1 lists the incidence rates of interval, study visit and combined urethral and anal gonorrhoea and chlamydia. The overall incidence of gonorrhoea was 5.90/100 person-years (95% CI 5.08 to 6.80), and that of chlamydia was 11.55/100 person-years (95% CI 10.43 to 12.75). The great majority (92% for gonorrhoea and 90% for chlamydia) of diagnoses of urethral infections was at the interval rather than the study visit. By contrast, for anal infections, 33% of gonorrhoea and 55% of chlamydia diagnoses were at the study visit.

Risk factors

Risk factors for urethral infections

In univariate analysis, urethral gonorrhoea was strongly associated with younger age, sexual contact with a person with

Table 1 Incidence rates of interval, study visit, and combined urethral and anal gonorrhoea and chlamydia infections in the Health In Men Study

	Interval diagnoses (from June 2000)			Study visit diagnoses (from January 2003)			Combined (from January 2003)		
	PY	n*	Incidence (/100 PY; 95% CI)	PY	n*	Incidence (/100 PY; 95% CI)	PY	n† (interval/study visit)	Incidence (/100 PY; 95% CI)
Gonorrhoea									
Urethral	4507	172	3.82 (3.28 to 4.42)	3020	8	0.26 (0.11 to 0.52)	3010	105 (97/8)	3.49 (2.86 to 4.21)
Anal	4512	96	2.13 (1.73 to 2.59)	3017	29	0.96 (0.64 to 1.38)	3011	89 (62/29)	2.96 (2.38 to 3.62)
Chlamydia									
Urethral	4499	315	7.00 (6.27 to 7.79)	3018	25	0.83 (0.54 to 1.22)	3002	223(200/28)	7.43 (6.52 to 8.43)
Anal†	3681	81	2.20 (1.75 to 2.73)	3016	83	2.75 (2.20 to 3.40)	3011	150 (74/83)	4.98 (4.23 to 5.82)

PY, person-years.
The discrepancies in PYs were due to missing reports and inhibited NAATs.
*Number of incident cases.
†The question about self-reported anal chlamydia was added to the questionnaire in January 2002.

gonorrhoea, a higher number of casual partners in the past 6 months and a variety of sexual behaviours with these partners that may have led to exposure of the urethra to gonorrhoea (table 2). In multivariate analysis, among those who reported casual partners, incident urethral gonorrhoea was associated with younger age, sexual contact with somebody known to have gonorrhoea, reporting more casual partners in the past 6 months and reporting UAI with HIV-positive casual partners (table 2).

Univariate predictors of incident urethral chlamydia included younger age, sexual contact with a person with chlamydia, a higher number of casual partners and a variety of sexual behaviours with those partners which may have led to exposure of the urethra to chlamydia (table 3). After adjustment, among those who reported casual partners, incident urethral chlamydia remained associated with younger age, sexual contact with a person known to have chlamydia, reporting more casual

Table 2 Risk factors for incident urethral gonorrhoea in the Health In Men Study (for those who reported casual partners)

	Incidence (/100 Person Years)	Univariate		Multivariate	
		HR (95% CI)	p Value	HR (95% CI)	p Value
Age* (years)			0.02†		0.04†
<25	10.13	1		1	
25–34	4.63	0.51 (0.27 to 0.97)		0.52 (0.27 to 1.00)	
35–44	3.56	0.41 (0.22 to 0.79)		0.42 (0.22 to 0.81)	
45–54	3.95	0.48 (0.23 to 1.00)		0.51 (0.24 to 1.08)	
>54	1.51	0.17 (0.04 to 0.77)		0.21 (0.05 to 0.96)	
Gonorrhoea contact			0.001‡		0.001‡
No	3.47	1		1	
Yes	21.96	5.57 (3.35 to 9.25)		4.14 (2.44 to 7.04)	
Number of casual partners in the past 6 months			0.001*		0.016*
1	0.00			1	
2–5	2.56	1			
6–10	4.68	1.84 (0.98 to 3.46)		1.89 (0.99 to 3.63)	
11–50	6.03	2.30 (1.33 to 3.97)		2.39 (1.35 to 4.21)	
>50	6.10	2.33 (1.10 to 4.95)		1.77 (0.78 to 4.00)	
Unprotected anal intercourse					
According to position			0.009‡		NA§
No UAI	3.32	1			
Insertive only	6.27	1.97 (1.16 to 3.34)			
Insertive and receptive	7.31	2.18 (1.29 to 3.69)			
Receptive only	4.18	1.27 (0.54 to 2.96)			
According to partner's HIV status			0.001†		0.032†
No UAI	3.32	1		1	
Negative only	2.03	0.67 (0.21 to 2.16)		0.56 (0.17 to 1.82)	
Some HIV unknown	6.77	2.01 (1.30 to 3.11)		1.45 (0.92 to 2.29)	
Some HIV positive	12.25	3.96 (1.79 to 8.74)		2.58 (1.10 to 6.05)	
Insertive oral sex with ejaculation			0.019†		0.574†
Never	3.26	1		1	
Occasionally	6.29	1.86 (1.23 to 2.81)		1.30 (0.84 to 2.03)	
Often	4.15	1.23 (0.44 to 3.44)		0.83 (0.29 to 2.38)	

NA, not applicable; UAI, unprotected anal intercourse.
Only those risk variables that were significant multivariate predictors, and those sexual behaviours, which could have led to exposure of the urethra to infection (insertive oral sex and UAI) are reported in this table.
*Attained age at each interview.
†p for trend.
‡p for homogeneity.
§Could not be included in the model because of the collinearity with UAI according to partner's HIV status.

Table 3 Risk factors for incident urethral chlamydia in the Health In Men Study (for those who reported casual partners)

	Incidence (/100 person years)	Univariate		Multivariate	
		HR (95% CI)	p Value	HR (95% CI)	p Value
Age* (years)			0.004†		0.016†
<25	10.03	1		1	
25–34	11.26	1.21 (0.67 to 2.17)		1.18 (0.64 to 2.18)	
35–44	8.51	0.93 (0.52 to 1.68)		0.96 (0.52 to 1.78)	
45–54	6.15	0.70 (0.36 to 1.38)		0.73 (0.36 to 1.48)	
>54	3.77	0.41 (0.15 to 1.16)		0.47 (0.16 to 1.34)	
Chlamydia contact			0.001‡		0.001‡
No	7.65	1		1	
Yes	43.58	5.37 (3.61 to 8.00)		4.61 (3.07 to 6.92)	
Number of casual partners in the past 6 months			0.001†		0.01†
1	4.39	1		1	
2–5	5.96	0.73 (0.34 to 1.55)		1	
6–10	8.50	1.43 (0.92 to 2.22)		1.14 (0.72 to 1.81)	
11–50	10.90	1.81 (1.25 to 2.63)		1.49 (1.01 to 2.19)	
>50	15.95	2.73 (1.69 to 4.43)		1.83 (1.09 to 3.06)	
Unprotected anal intercourse					
According to position			0.001‡		0.029‡
No UAI	7.61	1		1	
Insertive only	10.72	1.45 (0.98 to 2.14)		1.13 (0.75 to 1.70)	
Insertive and receptive	15.37	2.03 (1.42 to 2.91)		1.61 (1.10 to 2.35)	
Receptive only	4.84	0.64 (0.30 to 1.38)		0.55 (0.24 to 1.26)	
According to partner's HIV status			0.001†		
No UAI	7.61	1			NA§
Negative only	4.74	0.69 (0.32 to 1.47)			
Some HIV unknown	12.05	1.56 (1.14 to 2.13)			
Some HIV positive	20.56	2.92 (1.61 to 5.29)			
Insertive oral sex with ejaculation			0.001†		0.007†
Never	6.31	1		1	
Occasionally	12.90	1.96 (1.46 to 2.63)		1.54 (1.13 to 2.11)	
Often	12.59	1.95 (1.06 to 3.56)		1.65 (0.89 to 3.06)	

NA, not applicable; UAI, unprotected anal intercourse.
Only those risk variables that were significant multivariate predictors and those sexual behaviours that could have led to exposure of the urethra to infection (insertive oral sex and UAI) are reported in this table.
*Attained age at each interview.
†p for trend.
‡p for homogeneity.
§Could not be included in the model because of the collinearity with UAI according to position.

partners in the past 6 months and having more frequent insertive oral sex to ejaculation with casual partners (table 3).

In the stratified analyses, among participants who reported no insertive UAI, incident urethral gonorrhoea was associated with insertive oral sex to ejaculation with casual partners (p for trend 0.037), and incident urethral chlamydia was associated with insertive oral sex with ejaculation (p for trend <0.001) with casual partners.

Risk factors for anal infections

In univariate analysis, anal gonorrhoea was associated with younger age, sexual contact with a person with gonorrhoea, a higher number of casual sexual partners and a variety of sexual practices with these partners which may have led to the exposure of the anus to gonorrhoea (table 4). In multivariate analysis, among those who reported casual partners, incident anal gonorrhoea was strongly associated with younger age, sexual contact with a person known to have gonorrhoea, and reporting receptive UAI and frequent receptive fingering with casual partners (table 4).

Univariate predictors of anal chlamydia included sexual contact with a person with chlamydia, a higher number of casual sexual partners and a variety of sexual practices with these partners which may have led to the exposure of the anus to chlamydia (table 5). In multivariate analysis, among those who reported casual partners, incident anal chlamydia was strongly associated with sexual contact with a person with chlamydia, a greater number of casual sexual partners, receptive UAI and frequent receptive rimming with casual partners (table 5).

In the stratified analyses, among those who reported no receptive UAI, anal gonorrhoea was strongly associated with a variety of non-intercourse-receptive anal practices with casual partners, including fingering (p for trend 0.002), fisting (p for trend 0.001) and rimming (p for trend 0.001). Receptive fingering (p for trend 0.038) and use of dildos (p for trend 0.029) with casual partners were related to anal chlamydia.

DISCUSSION

Urethral and anal gonorrhoea and chlamydia were found to be very common infections in this cohort. The annual incidence of chlamydia, of nearly 12% at any site, was around twice that of gonorrhoea (6%). UAI was an important risk factor for both these infections. However, we have shown for the first time in a prospective epidemiological study that sexual activities other than penile–anal intercourse were associated with infections at each site. Urethral infections were associated with reporting insertive oral sex, and anal infections were associated with a range of non-intercourse receptive anal sexual practices.

Table 4 Risk factors for incident anal gonorrhoea in the Health In Men Study (for those who reported casual partners)

	Incidence (/100 person-years)	Univariate		Multivariate	
		HR (95% CI)	p Value	HR (95% CI)	p Value
Age* (years)			0.001†		0.001†
<25	8.61	1		1	
25–34	4.77	0.56 (0.28 to 1.12)		0.57 (0.29 to 1.13)	
35–44	2.67	0.31 (0.15 to 0.64)		0.31 (0.15 to 0.65)	
45–54	1.23	0.14 (0.05 to 0.42)		0.15 (0.05 to 0.44)	
>54	3.03	0.35 (0.11 to 1.11)		0.49 (0.15 to 1.55)	
Gonorrhoea contact			0.001‡		0.001‡
No	2.77	1		1	
Yes	20.81	7.48 (4.40 to 12.74)		5.59 (3.24 to 9.64)	
Number of casual partners in the past 6 months			0.004†		0.434†
1	2.77	1		1	
2–5	1.42	0.50 (0.17 to 1.47)		1	
6–10	4.22	1.50 (0.56 to 4.01)		1.82 (0.91 to 3.62)	
11–50	4.98	1.80 (0.71 to 4.58)		1.86 (0.99 to 3.47)	
>50	3.32	1.27 (0.39 to 4.18)		0.90 (0.33 to 2.44)	
Unprotected anal intercourse					
According to position			0.001‡		0.001‡
No UAI	2.30	1		1	
Insertive only	2.30	1.08 (0.48 to 2.44)		0.99 (0.44 to 2.24)	
Receptive withdrawal	7.08	3.22 (1.84 to 5.63)		2.15 (1.21 to 3.79)	
Receptive to ejaculation	11.70	5.34 (2.96 to 9.64)		3.48 (1.91 to 6.37)	
According to partner's HIV status			0.001†		NA§
No UAI	2.30	1			
Negative only	4.03	1.96 (0.83 to 4.67)			
Some HIV unknown	5.55	2.50 (1.53 to 4.11)			
Some HIV positive	14.09	7.15 (3.31 to 15.43)			
Receptive fingering			0.001†		0.001†
Never	1.55	1		1	
Occasionally	3.64	2.28 (1.20 to 4.34)		2.00 (1.04 to 3.83)	
Often	8.93	5.60 (2.81 to 11.16)		4.58 (2.26 to 9.28)	
Receptive fisting			0.007‡		0.376‡
Never	3.30	1		1	
Occasionally	11.08	3.23 (1.61 to 6.47)		1.93 (0.95 to 3.95)	
Often	0.00				
Receptive rimming			0.001†		0.241†
Never	1.16	1		1	
Occasionally	4.16	3.50 (1.66 to 7.39)		1.93 (0.86 to 4.31)	
Often	6.68	5.56 (2.46 to 12.56)		1.93 (0.77 to 4.83)	
Receptive of dildos			0.576‡		0.105‡
Never	3.43	1		1	
Occasionally	4.94	1.41 (0.78 to 2.56)		0.74 (0.39 to 1.38)	
Often	0.00				

NA, not applicable; UAI, unprotected anal intercourse.
Only those risk variables that were significant multivariate predictors and those sexual behaviours that could have led to exposure of the anorectum to infection (UAI, receptive fingering, fisting, rimming and use of dildos) are reported in this table.
*Attained age at each interview.
†p for trend.
‡p for homogeneity.
§Could not be included in the model because of the collinearity with UAI according to position.

Incidence data on gonorrhoea and chlamydia in homosexual men are rare. To our knowledge, the HIM Study is the first cohort study in homosexual men using a combination of biological measures and self-reported diagnoses to determine the incidence of these infections. A recent study found a self-reported incidence of gonorrhoea of 6.0/100 person-years in a cohort of young HIV-negative homosexual men in Amsterdam, The Netherlands.[18] In the US-based Explore cohort of HIV-negative homosexual men, 1.4–2.3% of men reported a diagnosis of gonorrhoea in each 6-month period, suggesting an annual incidence of 2.8–4.6%.[19] Our data suggest that self-reported diagnosis, as used in both these studies,[18 19] will substantially underestimate the incidence of anal infections. During the period of the HIM Study when men received NAAT, only 68% of all anal gonorrhoea infections and 45% of all anal chlamydia infections were self-reported, and the remainder were diagnosed at the study visit. By contrast, ⩽10% of urethral infections of both types were diagnosed at the study visit.

Although an association of urethral gonorrhoea and chlamydia with insertive UAI and insertive oral sex has been reported in a cross-sectional study on homosexual men,[20] the HIM cohort provides the first longitudinal data to consider this association. We found an association between insertive UAI

Table 5 Risk factors for incident anal chlamydia in the Health In Men Study (for those who reported casual partners)

	Incidence (/100 person-years)	Univariate HR (95% CI)	Univariate p Value	Multivariate HR (95% CI)	Multivariate p Value
Age* (years)			0.437†		0.925†
<25	6.97	1		1	
25–34	6.89	1.02 (0.50 to 2.09)		1.10 (0.52 to 2.34)	
35–44	5.00	0.75 (0.37 to 1.55)		0.84 (0.39 to 1.82)	
45–54	5.15	0.79 (0.36 to 1.75)		0.99 (0.43 to 2.30)	
>54	6.82	1.02 (0.41 to 2.59)		1.47 (0.56 to 3.86)	
Chlamydia contact			0.001‡		0.001‡
No	5.49	1		1	
Yes	17.11	3.03 (1.67 to 5.51)		2.70 (1.48 to 4.94)	
Number of casual partners in the past 6 months			0.001†		0.019†
1	2.19	1		1	
2–5	3.40	1.56 (0.54 to 4.51)		1	
6–10	6.00	2.80 (0.98 to 8.00)		1.48 (0.86 to 2.56)	
11–50	7.47	3.48 (1.26 to 9.59)		1.55 (0.96 to 2.51)	
>50	11.80	5.69 (1.95 to 16.59)		2.12 (1.16 to 3.90)	
Unprotected anal intercourse					
According to position			0.001‡		0.001‡
No UAI	4.01	1		1	
Insertive only	5.26	1.39 (0.80 to 2.41)		1.13 (0.65 to 1.99)	
Receptive withdrawal	12.82	3.24 (2.13 to 4.92)		2.62 (1.69 to 4.06)	
Receptive to ejaculation	14.64	3.66 (2.21 to 6.06)		2.98 (1.76 to 5.02)	
According to partner's HIV status			0.001†		NA§
No UAI	4.01	1			
Negative only	7.47	1.97 (1.04 to 3.75)			
Some HIV unknown	9.97	2.52 (1.74 to 3.66)			
Some HIV positive	15.66	4.35 (2.16 to 8.77)			
Receptive fingering			0.001†		0.562†
Never	3.61	1		1	
Occasionally	6.76	1.82 (1.18 to 2.81)		1.12 (0.71 to 1.79)	
Often	8.94	2.42 (1.41 to 4.15)		1.19 (0.65 to 2.18)	
Receptive fisting			0.006†		0.280†
Never	5.60	1		1	
Occasionally	13.47	2.40 (1.29 to 4.47)		1.47 (0.78 to 2.77)	
Often	12.89	2.21 (0.31 to 15.97)		1.22 (0.17 to 8.96)	
Receptive rimming			0.001†		0.004†
Never	2.32	1		1	
Occasionally	7.14	3.00 (1.76 to 5.12)		2.07 (1.19 to 3.61)	
Often	9.22	3.86 (2.10 to 7.11)		2.53 (1.35 to 4.76)	
Receptive of dildos			0.064†		0.763†
Never	5.55	1		1	
Occasionally	7.57	1.37 (0.85 to 2.21)		0.82 (0.50 to 1.35)	
Often	14.11	2.42 (0.77 to 7.65)		1.53 (0.47 to 5.03)	

NA, not applicable; UAI, unprotected anal intercourse.
Only age and those risk variables that were significant multivariate predictors and those sexual behaviours, that could have led to exposure of the anorectum to infection (UAI, receptive fingering, fisting, rimming and use of dildos) are reported in this table.
*Attained age at each interview.
†p for trend.
‡p for homogeneity.
§Could not be included in the model because of the collinearity with UAI according to position.

with casual partners and urethral infections in univariate analyses, but this association did not persist in multivariate analyses. However, we found evidence that urethral infections were related to insertive oral sex, both in multivariate analysis and in analyses confined to those who reported no insertive UAI.

Whether anorectal gonorrhoea is always due to receptive UAI in homosexual men has been questioned,[21 22] and it has been speculated that other sexual practices, such as digital–anal and oral–anal contact, could also be risk factors.[23] We found that receptive anal fingering and rimming with casual partners predicted anal gonorrhoea and chlamydia in multivariate analyses. Further, among those who reported no receptive UAI, a variety of receptive anal practices with casual partners were risk factors for anal infections. Our findings provide strong support for the hypothesis that receptive UAI is not necessary for anal infections. Indeed, 34% of diagnoses of anal gonorrhoea and 36% of diagnoses of anal chlamydia occurred in men who reported no receptive UAI with either casual or regular partners in the relevant risk period (data not shown).

Some strengths and limitations should be considered when interpreting our results.

Key messages

- Incident gonorrhoea and chlamydia are common in HIV-negative homosexual men in Sydney.
- In addition to unprotected anal intercourse, urethral infections are associated with insertive oral sex; and anal infections are associated with non-intercourse receptive anal practices.
- Screening that includes tests for anal and urethral infections should be offered to all sexually active homosexual men, not just to those who report unprotected anal intercourse.

The HIM Study has uncovered a high incidence of gonorrhoea and chlamydia in HIV-negative homosexual men in Sydney. Although study screening identified a limited number of people with urethral infections, a much larger number of people with anal infections were diagnosed. The study highlights the importance of sexual behaviours other than penile–anal intercourse in the epidemiology of these infections. For urethral infections, insertive oral sex was an important risk factor, and for anal infections, non-intercourse receptive anal practices were important. The independent association of anal infections with non-intercourse anal sexual practices suggests that comprehensive sexual health screening, particularly anal screening, should occur in all sexually active homosexual men, not just those who report UAI.

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Authors' affiliations

F Jin, G P Prestage, B Donovan, D J Templeton, J M Kaldor, A E Grulich, National Centre in HIV Epidemiology and Clinical Research, University of New South Wales, Sydney, New South Wales, Australia
L Mao, S C Kippax, National Centre in HIV Social Research, University of New South Wales, Sydney, New South Wales, Australia
C M Pell, Taylor Square Private Clinic, Darlinghurst, Australia
P H Cunningham, Centre for Immunology, St Vincent's Hospital, Sydney, New South Wales, Australia

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