ORIGINAL ARTICLE

Adolescence and other risk factors for *Chlamydia trachomatis* genitourinary infection in women in Melbourne, Australia

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Objective: To establish the prevalence of and risk factors for *Chlamydia trachomatis* infection to determine the role of universal versus targeted testing.
Methods: A prospective study of 1107 women attending two sexual and reproductive health clinics in Melbourne, Australia, was carried out. A questionnaire was used to establish risk factors. Urine samples were tested for *C trachomatis* by PCR. The main outcome measures were prevalence of and risk factors for *C trachomatis* infection.
Results: Of 1107 recruitable women, 851 (76.9%) consented and were successfully tested. *C trachomatis* was detected in 18 (4.8% (95% CI 2.9 to 7.5)) of 373 women in the inner city and eight (1.7% (95% CI (0.7 to 3.3)) of 478 women in the suburban clinic. Of women under 25 years, 17 (6.2% (95% CI 3.7 to 9.8)) of 273 in the inner city in contrast with three (1.7% (95% CI 0.4 to 5.0)) of 174 in the suburban clinic were infected. In the inner city clinic, age under 25 years (OR 5.4 (95% CI 0.7 to 41.5)), vaginal discharge (OR 4.1 (95% CI 1.5 to 11.1)), and recent change of sexual partner (OR 4.6 (95% CI 1.6 to 12.9)) were associated with *C trachomatis*. In contrast, in the suburban clinic, only vaginal discharge (OR 3.5 (95% CI 0.9 to 14.3)) and recent change of sexual partner (OR 3.4 (95% CI 0.8 to 15.7)) were identified as risk factors. Multivariate analysis showed that recent change of partner (OR 4.5 (95% CI 1.5 to 13.8)) was the most strongly associated independent risk factor for infection in the inner city clinic.
Conclusion: The high prevalence of *C trachomatis* indicates that universal testing should be undertaken in the inner city clinic. Young age may not be a risk factor for *C trachomatis* in more affluent populations with lower prevalence rates. No risk factors were identified with sufficient sensitivity and specificity to be useful for targeted testing. Prevalence and identifiable risk factors for *C trachomatis* are not transferable between populations, even in the same city.

Most *Chlamydia trachomatis* genitourinary tract infections in women are asymptomatic.[1] Infection may lead to significant long term complications including tubal factor infertility, tubal pregnancy, and chronic pelvic pain,[1] as well as facilitate HIV transmission.[2 3] The sequelae of *C trachomatis* infection are associated with the highest costs of any sexually transmitted infection excluding HIV.[1 4 5] In Victoria, Australia notifications for *C trachomatis* are increasing.[6]

There is a debate about the role and cost effectiveness of targeted versus universal testing for *C trachomatis*. Targeted testing in other countries has reduced prevalence of infection, subsequent pelvic infection,[7] and tubal pregnancies.[8 9] Highest prevalences have been found in women under 29 years.[10 11] However, because it has proved difficult to identify risk factors with high specificity and sensitivity, universal testing of young sexually active women has been advocated.[12] Further, the high reinfection rate has led to the suggestion that sexually active adolescent women should be tested 6 monthly.[13] In Victoria the Chlamydia Strategy suggests that universal testing becomes cost effective when the prevalence is above 2.1%.[14]

The objective of this study was to assess the role of targeted versus universal testing of women presenting to Family Planning Victoria (FPV). Specific aims were to determine the prevalence of *C trachomatis* and risk factors that could be used for targeting testing.

METHODS

Women attending two metropolitan FPV sexual and reproductive health clinics with contrasting populations in Melbourne were studied. The first was an inner city clinic with a predominately adolescent population (93% female; 80% under 25 years; high proportion from socioeconomically disadvantaged areas). The second was a suburban clinic in a more affluent district with a wider age distribution (95% female; 35% under 25 years). The study was approved by the FPV ethics committee.

All women attending the clinics during a 5 week period in 2001 were asked to participate. Informed consent was obtained. Practitioners used a structured questionnaire to collect demographic and sexual history details from participants. These included age, genitourinary symptoms (vaginal discharge, dysuria, lower abdominal pain, intermenstrual bleeding, post-coital bleeding, and dyspareunia), sexual history details, barrier contraception use, time of last voiding, and reason for attendance.

A first pass urine was stored and transported at 4°C, and tested within 96 hours. Detection of *C trachomatis* was undertaken by polymerase chain reaction (PCR) using Cobas Amplicor (Roche Molecular Diagnostics) using an internal co-amplified control target. Samples with controls testing negative twice were designated unassessable. Positive tests were confirmed by ligase chain reaction (LCR) using Abbott LCx (Abbott Laboratories).

Women positive for *C trachomatis* were treated and screened for gonorrhoea, trichomonas, syphilis, hepatitis B, and HIV, and had contacts traced.

Table 1 Reason for attendance at the clinics

	Inner city clinic			Suburban clinic		
	Pos (n=18)	Neg (n=355)	Total (n=373)	Pos (n=8)	Neg (n=470)	Total (n=478)
Contraception	3	118	121 (32.4%)	1	135	136 (28.5%)
Emergency contraception*	1	51	52 (13.9%)		30	30(6.3%)
Screening request	5	52	57 (15.3%)	2	88	90(18.8%)
Symptoms	3	26	29 (7.8%)	1	40	41(8.6%)
STI contact	2	4	6 (1.6%)		7	7(1.5%)
Pregnancy counselling	1	13	14 (3.8%)	1	24	25(5.2%)
Pregnancy test**	1	35	36 (9.7%)		28	28(5.9%)
Advice***	1	13	14 (3.8%)	1	38	39(8.2%)
Results		5	5 (1.3%)		7	7(1.5%)
Cervical smear***		2	2 (0.5%)	1	11	12(2.5%)
Colposcopy**					9	9(1.9%)
Unrecorded	1	36	37 (9.9%)	1	53	54(11.3%)

Difference in total number of women attending clinics for each reason: *p<0.0005, **p=0.05, ***p<0.05.

Analysis and statistics

Analysis was undertaken using STATA v7.0. Associations between each risk factor and infection status were assessed using Pearson's χ^2 test. Odds ratios (OR) with 95% confidence intervals (CI) were calculated. Variables that showed any evidence of association with infection on univariate analysis (p value <0.1) were included in a multivariate logistic regression model.

RESULTS

Participants

Of 1107 women attending during the study, 866 (78.2%) participated (376 (82.6%) of 455 in the inner city and 490 (75.2%) of 652 in the suburban clinic). The mean (range) ages of the women participating in the inner city and suburban clinics were 21.3 (16.3–38.3) and 23.0 (13.4–62.3) years respectively. The age distribution at the two clinics is shown in figure 1 (on the *STI* website) and the reasons for attendance in table 1.

Non-participants in the inner city clinic were *more* likely to be under 25 years (p=0.18), and *less* likely to have vaginal discharge (p=0.08), intermenstrual bleeding (p=0.03), dyspareunia (p=0.033), any symptom (p<0.005), use barrier contraception (p=0.03), or have had a recent change of partner (p=0.002). Non-participants in the suburban clinic were *less* likely to have lower abdominal pain (p=0.005), dyspareunia (p=0.013), any symptom (p=0.008), or use barrier contraception (p=0.034).

Prevalence

Of the 866 women tested, the urine was assessable in 851 (98.3%)—373 (99.2%) in the inner city and 478 (97.6%) in the suburban clinic. *C trachomatis* was detected in 18 (4.8% (95% CI 2.9 to 7.5)) of 373 women in the inner city and eight (1.7% (95% CI (0.7 to 3.3)) of 478 women in the suburban clinic. Of women under 25 years, 17 (6.2% (95% CI 3.7 to 9.8)) of 273 in the inner city in contrast with three (1.7% (95% CI 0.4 to 5.0)) of 174 in the suburban clinic were infected with *C trachomatis*. The prevalence in women overall and that in women under 25 years in the two clinics was significantly different (p<0.05).

Symptoms and risk factors

Infection was asymptomatic in five (29%) infected women in the inner city and three (38%) women in the suburban clinic (table 2). In the inner city clinic, age under 25 years (OR 5.4 (95% CI 0.7 to 41.5)), vaginal discharge (OR 4.1 (95% CI 1.5 to 11.1)), and recent change of sexual partner (OR 4.6 (95% CI 1.6 to 12.9)) were associated with *C trachomatis* (table 2). Multivariate analysis of data from the inner city clinic showed that recent change of partner (OR 4.5 (95% CI 1.5 to 13.8)) was the most strongly associated independent risk factor for infection (table 2). In contrast, in the suburban clinic, only vaginal discharge (OR 3.5 (95% CI 0.9 to 14.3)) and recent change of sexual partner (OR 3.4 (95% CI 0.8 to 15.7)) were identified as risk factors (table 2).

Other sexually transmitted infections

Two (11%) of the 18 women with *C trachomatis* were co-infected with *Neisseria gonorrhoea* (positive urine PCR and endocervical swab culture). No other sexually transmitted infections were detected.

DISCUSSION

Prevalence

The prevalence of *C trachomatis* is above the 2.1% threshold identified for universal testing in the inner city clinic but not the suburban clinic.[14–17] One possible explanation for the lower prevalence in the latter is that women attending the inner city clinic were significantly more likely to be attending for emergency contraception and pregnancy tests and therefore potentially more likely to be having unsafe sex. Against this is the absence of an association in this study between non-barrier contraception and *C trachomatis*.

Influence of non-participants

It is unclear whether non-participants were more or less likely than participants to have been positive for *C trachomatis* and consequently their influence on the true prevalence. Even in the unlikely event that all the non-participants were uninfected, the minimum overall prevalence would remain high at 4.0% (18/455). Similarly in the suburban clinic, the prevalence would not alter significantly if all non-participants were uninfected (1.2% (8/652)).

Previous studies in Australia

A study in 1988 in women presenting to FPV for a pelvic examination found a prevalence of 5.1%.[18] However this study is not comparable with the current study as *C trachomatis* was detected by direct immunofluorescence and culture. In addition, the selected clients in the earlier study were likely to have included a higher proportion of infected women and therefore overestimated the true prevalence. The prevalence in unselected women in the current study is therefore consistent with the increase in *C trachomatis* notifications in Victoria.[6]

Other studies in Australian women have shown variable prevalences for *C trachomatis* from 2.8%[19] to more than 5% in remote areas.[20 21] A study in women in an urban sexual health centre in Sydney showed a rise in prevalence from 1.8% to 3.5% between 1994 and 2000.[22]

Table 2 Crude and adjusted odds ratios for demographic and sexual history variables associated with *Chlamydia trachomatis* infection using logistic regression analysis

	Inner city clinic (n=373)						Suburban clinic (n=478)		
	No	% pos	Crude OR (95% CI)	Adjusted OR (95% CI)	Se	Sp	No	% pos	Crude OR (95% CI)
Age									
Under 25 years	273	6.2	5.4 (0.7 to 41.5)	3.9 (0.5 to 31.2)	98	24	171	1.8	1.1 (0.3 to 4.5)
25 years or over	83	1.2					302	1.7	
Vaginal discharge									
Yes	99	10.1	4.1 (1.5 to 11.1)	2.8 (0.9 to 8.0)	59	74	105	3.8	3.5 (0.9 to 14.3)
No	263	2.7					358	1.1	
Dysuria									
Yes	19	0					34	2.9	1.8 (0.2 to 15.4)
No	346	4.6					433	1.6	
Lower abdominal pain									
Yes	64	4.7	1.0 (0.3 to 3.6)				83	1.2	0.6 (0.8 to 5.4)
No	303	4.6					380	1.8	
Intermenstrual bleed									
Yes	45	2.2	0.4 (0.1 to 3.3)				48	2.1	1.2 (0.1 to 10.3)
No	317	5.0					416	1.7	
Postcoital bleeding									
Yes	18	5.6	1.1 (0.1 to 9.1)				34	2.9	1.8 (0.2 to 15.2)
No	346	4.9					425	1.6	
Dyspareunia									
Yes	52	7.7	1.9 (0.6 to 6.1)				72	0	
No	310	4.2					389	2.1	
Any symptom									
Yes	176	6.8	2.5 (0.9 to 7.3)				217	2.3	1.9 (0.4 to 8.0)
No	177	2.8					242	1.2	
Barrier contraception									
Yes	184	3.8	0.7 (0.3 to 1.9)				221	2.3	1.8 (0.4 to 7.7)
No	166	5.4					239	1.3	
Recent partner change									
Yes	102	9.8	4.6 (1.6 to 12.9)	4.5 (1.5 to 13.8)	63	73	85	3.5	3.4 (0.8 to 15.7)
No	258	2.3					381	1.1	
>4 partners ever									
Yes	200	6.0	2.0 (0.7 to 5.7)				259	1.9	2.0 (0.4 to 10.3)
No	159	3.1					203	1.0	
Last urine >2 hours									
Yes	160	5.6	1.4 (0.5 to 3.6)				160	2.5	2.5 (0.6 to 11.3)
No	190	4.2					296	1.0	

Se = sensitivity; Sp = specificity.
Only variables which were associated with infection (p value <0.1 in univariate analysis) were included in the multivariate logistic regression.

Previous studies overseas

Wide ranging prevalence rates have been documented in other countries, including studies in family planning clinics.[23–27] A recent study in young women in the United Kingdom, using urine PCR, showed a prevalence of 10%.[28] Higher rates have been recorded in some populations in the United States including family planning clinics[25] and sexually transmitted diseases clinics.[29] Rates as high as 27% have been documented in adolescents[30] and women in prison.[31]

Age as risk factor

In Victoria, 72% of notified *C trachomatis* infections are in individuals under 29 years and 48% are in those under 25.[6] The highest prevalence is in women between 20 and 29 years.[11] In this study, in the inner city clinic, women under 25 years were more than five times more likely to be infected, consistent with studies in other populations.[10]

In contrast, women under 25 years in the suburban clinic were not at increased risk. In this clinic, five of the eight infected women were over 25 years. There are three main differences in the two clinic populations that may have contributed to this difference: the suburban clinic has a lower prevalence of *C trachomatis*, a lower proportion of younger women, and a lower proportion of women from socioeconomically disadvantaged areas. In contrast with other sexually transmitted infections, *C trachomatis* has not been shown to be associated with socioeconomic factors independent of race and ethnicity.[32] The lack of an increased risk of infection in young women in the suburban clinic in our study is in accordance with other studies that have shown age to be a poor predictor of infection in populations with high affluence[33] and/or lower prevalence rates.[16 17]

Symptoms and partners as risk factors

C trachomatis infection was symptomatic in an unexpectedly high proportion of women. Vaginal discharge was significantly associated with *C trachomatis* in the inner city clinic where 10 (59%) of the infected women had vaginal discharge. In contrast, in the suburban clinic, only one (13%) of the infected women had this symptom. Previous studies have found between 70 and 90% of *C trachomatis* infection is asymptomatic.[1] The high proportion of infected women with symptoms in our study may be explained by selection bias as a result of symptomatic women being more likely to attend the clinics in this study. In the inner city clinic, recent change

of partner was also found to be significantly associated with *C trachomatis* infection, consistent with other studies.[34 35]

Logistic regression using the three variables most strongly associated with infection in the inner city clinic as predictors showed that recent change of partner was the strongest independent risk factor. In contrast, multiple regression analysis produced a moderate reduction in the adjusted OR for both age under 25 years and vaginal discharge suggesting that at least some of the crude association between these two variables and infection was due to confounding as a result of an association between these risk factors and recent change of partner.

Despite infection being symptomatic in an unexpectedly high proportion of women, no single symptom or combination of symptoms offers sufficient sensitivity and specificity to be useful as criteria for selective screening.

CONCLUSION

This study highlights the importance of undertaking local studies of prevalence and risk factors. It shows that identifiable risk factors for *C trachomatis* are not transferable between populations even in clinics run by the same organisation in the same city. It also suggests that well established risk factors such as age under 25 years may not be applicable in more affluent populations with lower prevalence rates.

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The figure appears on the *STI* website.

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REFERENCES

1 **Stamm WE**. Chlamydia trachomatis infections: progress and problems. *J Infect Dis* 1999;**179(Suppl 2)**:S380–3.
2 **Laga M**, Manoka A, Kivuvu M, *et al*. Non-ulcerative sexually transmitted diseases as risk factors for HIV-1 transmission in women: results from a cohort study. *AIDS* 1993;**7**:95–102.
3 **Fleming DT**. From epidemiological synergy to public health policy and practice: the contribution of other sexually transmitted diseases to sexual transmission of HIV infection. *Sex Transm Infect* 1999;**75**:3–17.
4 **Philpot CR**. Impact of Chlamydia and herpes infections on the community. *Aus Microbiol* 1986;**7**:11–17.
5 **Medicine Io**. Committeee on prevention and control of sexually transmitted diseases. In: R. BT, ed. *The hidden epidemic: confronting sexually transmitted diseases*. Washington DC: National Academy Press, 1997.
6 **Victorian Department of Human Services Public Health Division**. Surveillance of Notifiable Infectious Diseases in Victoria 2000. 2001. http://www.dhs.vic.gov.au/phd/vidb/
7 **Scholes D**, Stergachis A, Heidrich FE, *et al*. Prevention of pelvic inflammatory disease by screening for cervical chlamydial infection. *N Engl J Med* 1996;**334**:1362–6.
8 **Marrazzo JM**, Celum CL, Hillis SD, *et al*. Performance and cost-effectiveness of selective screening criteria for Chlamydia trachomatis infection in women. Implications for a national Chlamydia control strategy. *Sex Transm Dis* 1997;**24**:131–41.
9 **Egger M**, Low N, Smith GD, *et al*. Screening for chlamydial infections and the risk of ectopic pregnancy in a county in Sweden: ecological analysis. *Bmj* 1998;**316**:1776–80.
10 **Nelson HD**, Helfand M. Screening for chlamydial infection. *Am J Prev Med* 2001;**20**:95–107.
11 **VDoHS**. Surveillance of sexually transmissible diseases in Victoria, 1999. Melbourne: Victorian Government Department of Human Services, 2000. http://www.dhs.vic.gov.au/phb/0008010/0008010.pdf.
12 **Mosure DJ**. Genital Chlamydia infections in sexually active female adolescents: do we really need to screen everyone? *J Adolescent Health* 1997;**20**:6–13.
13 **Burstein GR**, Gaydos CA, Diener-West M, *et al*. Incident Chlamydia trachomatis infections among inner-city adolescent females. *JAMA* 1998;**280**:521–6.
14 **Public Health Division**, Department of Human Services Victoria. *Chlamydia Strategy for Victoria 2001–2004*. 2001. http://www.dhs.vic.gov.au/phb/sti/chiamydia/index.htm.
15 **Genc M**, Mardh A. A cost-effectiveness analysis of screening and treatment for Chlamydia trachomatis infection in asymptomatic women. *Ann Intern Med* 1996;**124(1 Pt 1)**:1–7.
16 **Marrazzo JM**, Fine D, Celum CL, *et al*. Selective screening for chlamydial infection in women: a comparison of three sets of criteria. *Family Planning Perspectives* 1997;**29**:158–62.
17 **Han Y**, Coles FB, Hipp S. Screening criteria for Chlamydia trachomatis in family planning clinics: accounting for prevalence and clients' characteristics. *Family Planning Perspectives* 1997;**29**:163–6.
18 **Kovacs GT**, Westcott M, Rusden J, *et al*. The prevalence of Chlamydia trachomatis in a young, sexually-active population. *Med J Aust* 1987;**147**:550–2.
19 **Garland SM**, Tabrizi S, Hallo J, *et al*. Assessment of Chlamydia trachomatis prevalence by PCR and LCR in women presenting for termination of pregnancy. *Sex Transm Infect* 2000;**76**:173–6.
20 **Tabrizi SN**, Paterson B, Fairley CK, *et al*. A self-administered technique for the detection of sexually transmitted diseases in remote communities. *J Infect Dis* 1997;**176**:289–92.
21 **Bowden FJ**, Paterson BA, Mein J, *et al*. Estimating the prevalence of Trichomonas vaginalis, Chlamydia trachomatis, Neisseria gonorrhoeae, and human papillomavirus infection in indigenous women in northern Australia. *Sex Transm Infect* 1999;**75**:431–4.
22 **Donovan B**. Rising prevalence of genital Chlamydia trachomatis infection in heterosexual patients at the Sydney Sexual Health Centre, 1994 to 2000. *Commun Dis Intell* 2002;**26**:51–4.
23 **Hilger TM**, Smith EM, Ault K. Predictors of Chlamydia trachomatis infection among women attending rural Midwest family planning clinics. *Infect Dis Obstet Gynecol* 2001;**9**:3–8.
24 **Kirkwood K**, Horn K, Glasier A, *et al*. Non-invasive screening of teenagers for Chlamydia trachomatis in a family planning setting. *Br J Family Planning* 1999;**25**:11–12.
25 **Begley CE**. The incremental cost of screening, diagnosis, and treatment of gonorrhea and chlamydia in a family planning clinic. *Sex Transm Dis* 1989;**16**:63–7.
26 **Stokes T**. Screening for Chlamydia in general practice: a literature review and summary of the evidence. *J Public Health Med* 1997;**19**:222–32.
27 **Zelin JM**, Robinson AJ, Ridgway GL, *et al*. Chlamydial urethritis in heterosexual men attending a genitourinary medicine clinic: prevalence, symptoms, condom usage and partner change. *Int J STD AIDS* 1995;**6**:27–30.
28 **Tobin JM**, Harindra V, Tucker LJ. The future of chlamydia screening. *Sex Transm Infect* 2000;**76**:233–4.
29 **Kinghorn GR**, Waugh MA. Oral contraceptive use and prevalence of infection with Chlamydia trachomatis in women. *Br J Vener Dis* 1981;**57**:187–90.
30 **Smith PB**, Phillips LE, Faro S, *et al*. Predominant sexually transmitted diseases among different age and ethnic groups of indigent sexuallyactive adolescents attending a family planning clinic. *J Adolesc Health Care* 1988;**9**:291–5.
31 **Holmes MD**, Safyer SM, Bickell NA, *et al*. Chlamydial cervical infection in jailed women. *Am J Public Health* 1993;**83**:551–5.
32 **Ellen JM**, Hessol NA, Kohn RP, *et al*. An investigation of geographic clustering of repeat cases of gonorrhea and chlamydial infection in San Francisco, 1989–1993: evidence for core groups. *J Infect Dis* 1997;**175**:1519–22.
33 **Best D**, Ford CA, Miller WC. Prevalence of Chlamydia trachomatis and Neisseria gonorrhoeae infection in pediatric private practice. *Pediatrics* 2001;**108**:E103.
34 **Oakeshott P**, Chiverton S, Speight L, *et al* Testing for cervical Chlamydia trachomatis infection in an inner city practice. *Fam Pract* 1992;**9**:421–4.
35 **Thewessen EA**, van der Meijden WI, Doppenberg HJ, *et al*. Screening for cervical Chlamydia trachomatis infections in two Dutch populations. *Genitourin Med* 1990;**66**:361–6.