

# Detection of *Chlamydia trachomatis* in an Australian high school student population

J Debattista, P Martin, J Jamieson, K Crane, I Dolton, S Russell-Hall, J DeSilva, R Hargrave, T Robinson, N Ryan, M Mortlock

*Sex Transm Infect* 2002;**78**:194–197

See end of article for authors' affiliations

Correspondence to: Joseph Debattista, 484 Adelaide Street, Brisbane, Queensland 4000, Australia; joedebat@powerup.com.au

Accepted for publication 7 March 2002

**Objective:** To assess the prevalence of *Chlamydia trachomatis* infections among an Australian high school adolescent population.

**Methods:** Over a 4 year period, 14 high schools were selected in which an infertility prevention programme targeting *C trachomatis* was delivered to senior student populations. Coded first catch urine specimens were analysed by Amplicor PCR and infected students treated. Data retrospectively obtained from chlamydia screening programmes conducted among disadvantaged young people detached from formal education were also collated for comparison.

**Results:** Of a total student test population of 1174, 15 (1.3%; 95% CI 0.7% to 2.1%) were diagnosed with *C trachomatis*. Of 516 females and 658 males, 12 (2.3%; 95% CI 1.1% to 4.1%) and 3 (0.5%; 95% CI 0.1% to 1.4%) were tested positive respectively. Data collated for three populations of disadvantaged youth returned at total of 89 *C trachomatis* infections out of 560 people (15.9% 95%CI 13.0–19.2%).

**Conclusion:** The overall prevalence of *C trachomatis* infection among this population of senior high school adolescents is low, and significantly differs from the higher chlamydia rates detected in disadvantaged adolescents detached from formal schooling ( $p < 0.0001$ ).

*Chlamydia trachomatis* is now recognised as a major cause of sexually transmitted infections (STI) through out the world, particularly among people under 25 years of age living in industrialised nations<sup>1–3</sup> and has received significant attention as the most common bacterial sexually transmitted infection and the primary aetiological factor for epididymitis in males,<sup>4</sup> pelvic inflammatory disease (PID),<sup>1</sup> tubal infertility,<sup>5</sup> and ectopic pregnancy in females.<sup>6</sup>

The epidemiology of *C trachomatis* within Australia has traditionally been centred on indigenous Aboriginal populations, and young people under the age of 25 years. Extensive research has identified the high rates of chlamydia infection within indigenous communities across a range of regional and remote locations.<sup>7</sup> The prevalence of *C trachomatis* among young people has been less defined. A range of overseas studies have identified rates of 5–20% among a variety of young cohorts, ranging from high schools,<sup>8–10</sup> university health clinics,<sup>10 11</sup> family planning clinics,<sup>3</sup> detention centres,<sup>10 12 13</sup> military clinics,<sup>10</sup> adolescent clinics,<sup>14–16</sup> and employment centres.<sup>17 18</sup> While unpublished data are available for young Australian populations disengaged from the education system—for example, people in detention, indigenous communities, or detached youths, there have been no studies to date of the general youth population still attending high schools in Australia. This is a significant gap in epidemiological knowledge, given that young people form one of the most significant core transmitter groups for *C trachomatis*.<sup>3</sup> Given the global trends for the increasing detection of chlamydial infections among young people,<sup>19</sup> consideration has been given to establishing cost effective programmes with a primary focus set on the early detection and treatment of chlamydia infections.<sup>20</sup>

We previously reported on a pilot conducted in three Brisbane high schools which sought to develop an acceptable methodology of on-site screening for *C trachomatis* among high school students.<sup>21</sup> That original trial reported favourable results with respect to promoting awareness of sexually transmitted infections and familiarising students with the import-

ance of regular sexual health examinations. Following on from this first trial an ongoing system of regular chlamydia screening has been conducted in selected Queensland high schools as part of an infertility prevention campaign and as an attempt to identify whether those young people within the school system are at an equivalent risk of infection to those detached from formalised education.

## MATERIALS AND METHODS

### Student population

A total of 1174 high school students (516 females and 658 males), aged between 15 and 18 years, volunteered to provide first catch urine samples.

### School selection

Fourteen schools were involved in the programme over a 4 year period: four were non-government secondary colleges of religious affiliation; seven were large urban government high schools located in outlying suburban areas of Brisbane, three were small rural state high schools. Of those schools expressing interest in the programme, only those which demonstrated clear support by the local school health nurse, school management, parents' and citizens' committees were involved.

### Preliminary school consultations

Once final approval was obtained by school administration and local parents' and citizens' associations, a letter outlining the project proposal was sent by mail to each parent of the participating student group informing them of the purpose, methodology and protocol of the study. Each local parents' and citizens' committee was given the option of deciding whether parental consent (opting in) or parental dissent (opting out) would be selected. With the exception of three schools, written parent dissent was sought and forms were enclosed in the letter for this purpose. Those students for whom parental dissent had been obtained were not included in the screening process.

**Table 1** Annual results of chlamydia screening recorded in 14 Queensland high schools 1998–2001

Year	Sex	Total tested	Positive
1998	Female	170	2 (1.2%)
	Male	339	0
1999	Female	147	5 (3.4%)
	Male	132	1 (0.8%)
2000	Female	101	0
	Male	94	0
2001	Female	98	5 (5.1%)
	Male	93	2 (2.1%)
1998–2001	Female	516	12 (2.3% 95% CI 1.1% to 4.1%)
	Male	658	3 (0.5% 95% CI 0.1% to 1.4%)
	Total	1174	15 (1.3% 95% CI 0.7% to 2.1%)

**Student screening**

Those students whose parents had not dissented were allocated arbitrary appointment times at 5–10 minute intervals. Testing was voluntary, and students were free to change appointments or not attend.

The specimen collection was conducted on site. Those students who attended for testing received an individual 5–10 minute “pretest” information session with the specimen collection nurse. First catch urine samples were collected and coded by the attending nurse who maintained a register of codes. Coded specimens were transported to the Brisbane Sexual Health Clinic for analysis by polymerase chain reaction (PCR). All coded results were returned to the testing nurse for cross matching with student names.

All results were returned to students on an individual basis. Students receiving a positive test result were referred on for treatment (single oral dose of azithromycin).

**Statistical analysis**

Data for *C trachomatis* PCR tests conducted among three populations of disadvantaged youth (indigenous, non-indigenous, and a mixed sample within an adolescent detention centre) between 1998 and 2001 were retrospectively collected from computerised pathology records. Testing among these populations formed part of a routine screening programme operated

by two community based youth health services. Data accumulated over 4 years of screening high schools were collated on a yearly basis, and the total proportion of infected males and females calculated. Sample size was calculated on the basis of a previously identified prevalence of 4% among sexually active adults accessing the sexual health clinic on any given month. To estimate the proportion of infections to within 0.02 (2%)—that is, standard error = 0.01 a minimum sample size of 384 was required.

Statistical significance between total populations of school students and disadvantaged youth were determined calculating confidence intervals for small proportions.

**RESULTS**

Over 4 years of testing across 14 high schools, 1174 students, 516 females and 658 males aged between 15 and 18 years, were voluntarily tested. The great majority of these students were year 12 (16–18 years), this being the prime target of the programme.

With the exception of three schools, all schools agreed to the opting out system of parental dissent. In each school, only a small minority (1–6%) of parents dissented while the three schools seeking parental consent achieved a rate of parental approval ranging from 30–60%. Student participation rates varied with each school, ranging from 30–50% of the total year level student population with some rural schools recording higher participation of the order of 80%.

Of a total student test population of 1174, 15 (1.3%; 95% CI 0.7 to 2.1%) were diagnosed with *C trachomatis*. Of 516 females and 658 males, 12 (2.3%; 95% CI 1.1 to 4.1%) and three (0.5%; 95% CI 0.1–1.4%) were tested positive respectively, with no significant difference between sexes. There was no significant difference between students from rural (n= 81) and urban schools (n= 1093), and those enrolled in private (n=288) or government schools (n=886). While some school populations did return a positive result and others didn’t, there was no significant difference in infection prevalence across schools or over the 4 year period of testing. Testing conducted over the 4 years returned the annual results shown in table 1.

No trend in number or proportion of infections was evident over time. Overall a higher proportion of infected females were identified which approached statistical significance. Again there was no time related trend.

Of the total student sample tested, 40 were students of indigenous background. Of this group, three tested positive for *C trachomatis* (7.5%). One school with a significant indigenous population, of whom 30 volunteered for testing, returned a chlamydia prevalence rate of 6.7% among its indigenous students, while the prevalence rate among the 30 non-indigenous students was 13.3%.

**Table 2** Results of screening programmes (1998–2001) targeting disadvantaged youths

Population	Sex	Total tested	Positive
Detached youths indigenous	Female	154	33 (21.4%)
	Male	110	13 (11.8%)
	Combined	264	46 (17.4% 95%CI13.0% to 22.1%)
Detached youths non-indigenous	Female	47	5 (10.6%)
	Male	38	4 (10.5%)
	Combined	85	9 (10.6% 95%CI5.0% to 19.1%)
Detention centres	Female	48	11 (22.9%)
	Male	163	23 (14.1%)
	Combined	211	34 (16.1% 95%CI11.4% to 21.8%)
Total	Female	249	49 (19.7%)
	Male	311	40 (12.9%)
	Combined	560	89 (15.9% 95%CI13.0% to 19.2%)

Data recorded in computerised pathology records were available for three populations of disadvantaged youth tested by PCR over the same time period. Of a total of 249 females and 311 males tested, 49 (19.7%) and 40 (12.9%) positive results were recorded respectively. Results of these various screening programmes are described in table 2.

No significant differences were noted between indigenous and non-indigenous young people, between those in detention and outside of it, and between males and females. However comparison of the proportion of high school students infected with *C trachomatis* (1.3% 95%CI 0.7 to 2.1) and infected disadvantaged youths (15.9% 95%CI 13.0 to 19.2) show a significant difference ( $p < 0.0001$ ).

## DISCUSSION

As part of an infertility prevention project targeting senior high school students, Brisbane Sexual Health and AIDS Services commenced piloting the methodology required for the conduct of a urine screening programme within high schools for the early detection and treatment of chlamydia infections in adolescents.<sup>21</sup> Following on from this pilot, a further 10 schools were selected for screening.

It should be acknowledged that both schools and students self select for testing and therefore a degree of sample bias does exist. A number of large outer urban high schools were involved, located in areas recognised for lower income and high unemployment and therefore more representative of the lower socioeconomic spectrum. This may have biased the sample towards those socioenvironmental factors conducive to the maintenance of STI endemicity.<sup>22</sup>

The selection of students within each school was voluntary and consequently carried a further degree of selection bias. Sexual histories were not taken, therefore it is not possible to determine what proportion of the tested population was sexually active or not. The decision not to record histories was deliberate in an effort to maximise parental support and student participation.

None the less, two previous sexual behaviour surveys of 1264 students enrolled in Queensland high schools<sup>23</sup> showed that by year 12, nearly 50% of students had reported sexual intercourse. This rate has remained stable over 3 years between 1992 and 1995. Notwithstanding the selection bias of a voluntary testing programme to either encourage or discourage the participation of sexually active students, it could therefore be assumed that of the sample tested in this school screening programme, 50% were sexually active. Therefore the low prevalence of *C trachomatis* infection detected in this study (1.3% 95% CI 0.7 to 2.1) needs to be considered within the context of a population in which almost 50% of participants may not be sexually active.

The overall prevalence rate detected among these high school student populations mirrors that identified in a group of 178 female university students (1.1%) tested in Brisbane,<sup>24</sup> and is similar to the prevalence detected among those adult clients attending the Brisbane Sexual Health Clinic on any given month (3–5%), homosexual patrons attending recreational venues (4.3%),<sup>25</sup> and those incarcerated in adult male and female prisons (4.1%, 5.1%) (unpublished data). However, this sample of school students does have a significantly lower prevalence of *C trachomatis* ( $p < 0.0001$ ) when compared with other subpopulations of detached or “homeless” young people screened through various testing programmes (15.9% 95% CI 13.0 to 19.2%).

As a “case finding” exercise for the detection and treatment of *C trachomatis* infections in high school populations, the overall prevalence rate detected (0.5%–2.3%) does not provide a clear argument in support of routine screening of all student populations. Screening programmes conducted in the United States, among young people both within<sup>8</sup> and external to the education system,<sup>3</sup> have demonstrated the cost effectiveness

for testing populations with 2% or higher infection prevalence. These American studies indicated age less than 20 years as the strongest sociodemographic predictor of chlamydia infection. Although selective screening has been shown to be feasible in adult populations, this was not demonstrated for adolescents but rather supported the need for universal screening of sexually active adolescent females.

The high prevalence of *C trachomatis* identified in our studies among young people disengaged from the education system (15.6%), be they residents of youth shelters, detention centres, or homeless (see table 2), appears to indicate that infection is predominantly localised among detached youth—a significant “core” group, and that connection to formal education may be a significant cofactor in determining risk for infection. Therefore, contrary to the American studies, our high school results would suggest that selective screening is appropriate within adolescent populations and should target those detached from formal education.

However, a limitation in comparing our school data with those of disadvantaged young people, is again selection bias. A much higher proportion of disadvantaged youths tested will have been sexually active, and given the different settings for screening, those volunteering for testing among marginalised youth may have identified greater sexual risk and therefore a higher prevalence. None the less, even if the high school prevalence were doubled to account for the approximately 50% of non-sexually active participants, infections within a school based population would still be significantly lower.

The higher rate of infection among homeless or marginalised young people may reflect the influences of poor education, lower income, and poor access to health services owing to consequent feelings of powerlessness. These populations of marginalised youths also include a higher proportion of indigenous young people, which in turn may interact frequently with or occupy particular urban/rural social networks where a pool of infection has been allowed to develop over a number of years without adequate medical intervention. The indigenous students tested within our school population returned a 6.7% infection rate, higher than the 1.3% among non-indigenous students, but not statistically significant given the very small number of indigenous students tested overall. However, at one school with a high indigenous population, the prevalence of infection among non-indigenous students (13.3%) was double that found in the indigenous sample (6.7%). Again, numbers were too small for any meaningful comparison, but this may indicate that despite the significantly high prevalence rates of chlamydia detected in marginalised indigenous youth, rates of infection among indigenous and non-indigenous students completing year 12 may be equivalent. Therefore, connection with formalised education and the corresponding social networks may provide a degree of protection for young people.

The concept of social networks may help to explain the higher, though not statistically significant, prevalence of *C trachomatis* detected in the female year 12 student population (2.3% v 0.5%). Anecdotal information indicates that female students at the senior school level tend to form relationships with older males external to the school system, while male students of the same year level tend to relate to younger girls, predominantly within the same school system. Female students are therefore linked with a wider social network, more vulnerable to infection given the greater number of intersections with other subpopulations. Male students however, form relationships within more exclusive and small social networks localised within the school community, thereby reducing overall exposure to a range of potential pools of infection.

The overall prevalence of *C trachomatis* detected in our high school population, while approaching a level of cost effectiveness for universal screening as reported in American studies, is still less. Of greater importance is the selecting out of

### Key messages

- A urine screening protocol for the detection of sexually transmitted infections (STI) can be successfully implemented in high school settings with minimal disruption and wide acceptance by school administrators, parents, and students
- The overall prevalence of *C trachomatis* infection among school based population of adolescents is low
- Chlamydia rates detected in disadvantaged adolescents detached from formal schooling are significantly higher ( $p < 0.0001$ ), and which therefore suggests that schooling is an important cofactor in determining risk for infection

subpopulations within this group who are at greater risk of infection. However, putting aside the importance of case finding and treatment, a screening programme such as this could prove to be of significant educational value to students by facilitating a “practical experience” of sexual health promotion. Familiarising the student with STI testing, even in a limited way, could help to reduce the ambivalence, embarrassment, and discomfort with which sexual health is regarded by many.

### ACKNOWLEDGEMENTS

We acknowledge the support of the laboratory staff of the Brisbane Sexual Health Clinic and the Division of Microbiology, Royal Brisbane Hospital who performed the PCR analysis of the urine specimens and particularly Narelle George who supplied pathology data for analysis; the administrative and teaching staff of the participating schools; and the health staff of the Brisbane Youth Service and Indigenous Youth Health Service (Aboriginal and Islander Community Health Service).

### CONTRIBUTORS

JD developed and coordinated overall screening programme and prepared the manuscript; PM coordinated and assisted with rural school screening; JJ conducted urban screening (three schools); KC conducted rural screening (two schools); ID conducted urban screening (two schools); SR-H conducted urban screening (one school); JD conducted urban screening (one school); RH conducted urban screening (one school); TR conducted rural screening (one school); NR conducted urban screening (one school); MM provided statistical advice and analysis.

### Authors' affiliations

**J DeBattista**, Centre for Molecular Biology, Qld University of Technology/Sexual Health and AIDS Service, The Prince Charles Hospital Health Service District, Brisbane, Australia  
**P Martin**, Central Public Health Unit Network-Wide Bay  
**J Jamieson**, QEII Health Service District, Brisbane  
**T Robinson**, Bundaberg Health Service District, Bundaberg, Queensland, Australia  
**M Mortlock**, School of Mathematics, Qld University of Technology

### REFERENCES

- 1 **Westrom L**, Mardh PA. Acute pelvic inflammatory disease. In: Holmes KK, Mardh P-A, Sparling PF, Wiesner PJ, eds. *Sexually transmitted diseases*. New York: McGraw-Hill, 1990:593–615.
- 2 **Randolph AG**, Washington AE. Screening for Chlamydia trachomatis in adolescent males: a cost-based decision analysis. *Am J Pub Health* 1990;**80**:545–50
- 3 **Mosure DJ**, Berman S, Fine D, et al. Genital chlamydia infections in sexually active female adolescents: do we really need to screen everyone? *J Adoles Hlth* 1997;**20**:6–13.
- 4 **Berger RE**. Acute epididymitis. In: Holmes KK, Mardh P-A, Sparling PF, Wiesner PJ, eds. *Sexually transmitted diseases*. New York: McGraw-Hill, 1990:641–53.
- 5 **Moore DE**, Cates W. Sexually transmitted diseases and infertility In: Holmes KK, Mardh P-A, Sparling PF, Wiesner PJ, eds. *Sexually transmitted diseases*. New York: McGraw-Hill, 1990:763–71.
- 6 **Wolner-Hanssen P**, Kiviat NB, Holmes KK. Atypical pelvic inflammatory disease: subacute, chronic, or subclinical upper genital tract infection in women. In: Holmes KK, Mardh P-A, Sparling PF, Wiesner PJ, eds. *Sexually transmitted diseases*. New York: McGraw-Hill, 1990:615–21.
- 7 **Skov S**, Miller P, Hateley W, et al. Urinary diagnosis of gonorrhoea and chlamydia in men in remote Aboriginal communities. *Med J Aust* 1997;**166**:468–71.
- 8 **Nsuami M**, Cohen DA. Participation in a school-based sexually transmitted disease screening program. *Sex Transm Dis* 2000;**27**:473–8
- 9 **Klausner JD**. Screening adolescent females for chlamydia infection [letter]. *JAMA* 1999;**281**:513–15
- 10 **Shafer M-A**, Schachter J, Moncada J, et al. Evaluation of urine-based screening strategies to detect Chlamydia trachomatis among sexually active asymptomatic young males. *JAMA* 1993;**270**:2065–70.
- 11 **Adger H**, Shafer M-A, Sweet RL, et al. Screening for Chlamydia trachomatis and Neisseria gonorrhoeae in adolescent males: value of first catch urine examination. *Lancet* 1984;.
- 12 **Risser JMH**, Risser WL, Geffer LR, et al. Implementation of a screening program for chlamydial infection in incarcerated adolescents. *Sex Transm Dis* 2001;**28**:43–6.
- 13 **Morris RE**, Legault J, Baker C. Prevalence of isolated urethral asymptomatic Chlamydia trachomatis infection in the absence of cervical infection in incarcerated adolescent girls. *Sex Transm Dis* 1993:198–200
- 14 **Oh MK**, Cloud GA, Fleenor M, et al. Risk for gonococcal and chlamydial cervicitis in adolescent females: incidence and recurrence in a prospective cohort study. *J Adoles Hlth* 1996;**18**:270–5.
- 15 **Fraser JJ**, Rettig PJ, Kaplan DW. Prevalence of cervical Chlamydia trachomatis and Neisseria gonorrhoeae in female adolescents. *Pediatrics* 1983;**71**:333–6.
- 16 **Blythe MJ**, Katz BP, Batteiger BE, et al. Recurrent genitourinary chlamydial infections in sexually active female adolescents. *J Pediatr* 1992;**121**:487–93.
- 17 **Lifson AR**, Halcon LL, Hannan P, et al. Screening for sexually transmitted infections among economically disadvantaged youth in a national job training programs. *J Adoles Health* 2001;**28**:190–7.
- 18 **Werner MJ**, Biro FM. Urinary leukocyte esterase screening for asymptomatic sexually transmitted disease in adolescent males. *J Adoles Health* 1991;**12**:326–8.
- 19 **Schachter J**. Chlamydia trachomatis: the more you look, the more you find—how much is there. *Sex Transm Dis* 1998;**25**:229–31.
- 20 **Hillis SD**, Nakashima A, Amsterdam L, et al. The impact of a comprehensive chlamydia prevention program in Wisconsin. *Fam Plan Persp* 1995;**27**:108–11.
- 21 **DeBattista J**, Lines D, Patten J, et al. Early detection of Chlamydia trachomatis in senior high school student populations—a pilot study. *Venereology* 1998;**11**:19–23.
- 22 **Wasserheit JN**, Aral SO. The dynamic topology of sexually transmitted disease epidemics: Implications for prevention strategies. *J Infect Dis* 1996;**174**:S201–13.
- 23 **Ballard R**, Dunne M, Peterson K. Queensland secondary school students' knowledge of sexually transmissible diseases, attitudes toward people with HIV infection and patterns of sexual behaviour. Brisbane, Education Queensland, 1997.
- 24 **DeBattista J**, James M, Lines D, et al. Early detection of Chlamydia trachomatis in university residential colleges. *Venereology* 1999;**12**:35–6.
- 25 **DeBattista J**, Dwyer J, Orth D, et al. Community screening for Neisseria gonorrhoeae and Chlamydia trachomatis among patrons of sex-on-premises venues—two years later. *Venereology* 2000;**13**:105–9.