Chlamydia trachomatis epidemiology in Canadians of Chinese ethnicity: A population-based study

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ABSTRACT

OBJECTIVES: To compare the rates of *Chlamydia trachomatis* infection between those of Chinese ethnicity and non-Chinese ethnicity in a large Canadian urban setting.

METHODS: We examined rates of *Chlamydia* among residents of Vancouver and Richmond, Canada, by Chinese and non-Chinese ethnicity, from 2006 to 2010. We stratified cases by age group, sex and ethnicity. We analyzed 12,555 cases of *Chlamydia* from 2006 to 2010.

RESULTS: The overall rate of *Chlamydia* was 276 per 100,000 per year. *Chlamydia* rates were 236 per 100,000 among those of Chinese ethnicity and 338 per 100,000 among non-Chinese. While overall rates among individuals of Chinese ethnicity were lower, rates among older Chinese women were significantly higher than among their non-Chinese counterparts.

CONCLUSIONS: Physicians serving patients of Chinese ethnicity should be aware that rates among Chinese-Canadians are substantial, with rates among older women higher than among non-Chinese women, and they should consider this when screening for sexually transmitted infections in this population. Further research is needed to elucidate why this is the case.

KEY WORDS: *Chlamydia*; Chinese; immigrants; sexually transmitted infections

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Can J Public Health 2014;105(2):e116-e120.

Infection with *Chlamydia trachomatis* is the most common sexually transmitted infection (STI) in Canada.¹ In 2008, there were 248.9 infections reported per 100,000, representing an 80.2% increase since 1998.¹ Rates of notification in men more than doubled between 1999 and 2008, increasing from 81.4 to 168.7 per 100,000. Among women, rates have also increased, from 193.6 to 327.4 per 100,000 population from 1999 to 2008. Increased rates of screening, advances in molecular diagnostics, the opportunity for patients to give non-invasive urine specimens, and higher numbers of re-infection may account for some of these increases. Improved detection may not account for all of the increase, however, as the 2009 Canadian *Chlamydia* rate and the 2010 rate continued to rise (259 per 100,000 and 277.6 per 100,000 in 2009 and 2010, respectively).²

In women, *Chlamydia* infection can cause a spectrum of disease, ranging from asymptomatic infection to pelvic inflammatory disease.³ In particular, infertility may result from untreated infection. Because *Chlamydia* infections can cause significant morbidity and are largely preventable, this is an infection of public health concern. Case finding has two immediate goals: 1) to prevent complications in the case and 2) by treating the case and sexual partners, to prevent further spread of the disease.

Not much is known about *Chlamydia* infection rates among people of Chinese ethnicity in Canada. Vancouver and Richmond, British Columbia, are adjacent municipalities with a high proportion of visible minorities. The 2006 Canadian Census found

that approximately 50.5% and 65% of Vancouver and Richmond residents, respectively, self-identified as belonging to a visible minority; people of Chinese ethnicity predominated.⁴ In the United States, *Chlamydia* rates vary significantly by race, from a high of 2,056.9 per 100,000 population in African Americans to a low of 225.9 per 100,000 among Asians/Pacific Islanders in 2008.⁵ Thus it is conceivable that *Chlamydia* infections may also vary significantly among different ethnic groups in Canada. While US data suggest that *Chlamydia* incidence may be comparatively low among ethnic Chinese in Vancouver and Richmond, local ethnicity-specific data on *Chlamydia* rates are lacking. Understanding the local epidemiology of *Chlamydia* will allow public health practitioners to tailor STI prevention programs in Vancouver and Richmond to the local disease burden and cultural context.

Current Canadian guidelines suggest screening for STIs in women with known risk factors.⁶ These guidelines do not recommend screening for women over the age of 25 in stable, monogamous relationships. For immigrants and refugees, the guidelines suggest a “non-judgmental and culturally sensitive STI risk assessment.” There are no separate recommendations about

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Conflict of Interest: None to declare.

Figure 1. Flow chart summarizing the selection of cases to include in the analysis

Chlamydia screening for immigrants and refugees. In our paper, we examine the descriptive epidemiology of *Chlamydia* rates in Vancouver and Richmond. In particular, we examine rates of *Chlamydia* among Chinese-Canadians to assess whether current STI programs and guidelines are appropriate in Vancouver and Richmond, BC.

METHODS

Diagnosis of *Chlamydia* relies on laboratory detection of the organism. All laboratories in BC use nucleic acid amplification testing on vaginal or urethral swabs or urine specimens. Positive results are usually confirmed by repeating the test. Tests from three different manufacturers are used in BC laboratories: BD Probetec™, Roche and Gen-probe. These three manufacturers use one of three assays: polymerase chain reaction, transcription-mediated amplification or strand displacement amplification. All three methods, run with a single test, have a specificity of greater than 99%.⁷

The public health care system in BC is organized into six regional health authorities.⁸ Under the *Public Health Act* of BC, *Chlamydia* is reportable to the local health authority, and the BC Centre for Disease Control (BCCDC) carries out public health follow-up on behalf of the regional health authorities. BCCDC collects, from the health care practitioner, information on the case's date of birth (age), sex, ethnicity, sexual orientation and address, and the address of the clinic/hospital where the case tested positive. The ethnicity field captures the following categories: Asian, Caucasian, Arab, Black, South Asian, First Nations and Other.

We examined cases of *Chlamydia* infection that occurred from 2006 to 2010 and were reported to the local health authority under the *Public Health Act*. We first tabulated the total number of cases of *Chlamydia* reported for Vancouver and Richmond residents from 2006 to 2010. Cases were included if either a correct physical address or postal code for Vancouver or Richmond was available

(Figure 1). We performed a cross-check of the Ministry of Health's client registry to determine whether cases were Vancouver or Richmond residents. We excluded cases whose address was unknown or was not in Vancouver or Richmond. We also excluded cases if there had been a repeat test within an interval of less than 90 days or if the age was less than 10 years.

We then stratified the number of cases by age group, sex and Chinese or non-Chinese ethnicity. We were interested in analyzing by Chinese and non-Chinese ethnicity because over 50% of the population in Vancouver are part of a visible minority and over 50% self-reported as Chinese in the 2006 Canadian Census.⁴ Similarly, 60% of the population in Richmond are in a visible minority and over 40% self-reported their ethnicity as Chinese in the 2006 Canadian Census.⁴ However, completion of the ethnicity field in case records was inconsistent and found to be not useful, as some clearly Chinese names were classified as another ethnicity or not classified at all. We were only able to identify Chinese ethnicity with any confidence using a surname and first name analysis of the case records. Some of the names in the raw data set that were clearly Chinese had been coded as another ethnicity or lacked an ethnicity code. The ethnicities of these cases were changed to Chinese. To identify Chinese names, we used an algorithm developed at Vancouver Coastal Health Public Health Surveillance Unit. Ambiguous names were checked manually – most of these were able to be classified as Chinese or non-Chinese. Three of the authors have good knowledge of Chinese names. To avoid overcounting Chinese cases, we classified any ambiguous names as non-Chinese. Thus, although misclassification bias could be present, it would be biased to the null hypothesis and would likely lead to underestimates of the true rates among those of Chinese ethnicity.

To calculate the average population rate for 2006-2010, we used population estimates data (2006-2010) from BC Stats and BC Ministry of Citizens' Services for Vancouver and Richmond.⁹ We

Figure 2. Chlamydia notification per 100,000 population by sex and age group, 2006-2010 combined

Figure 3. Chlamydia notification per 100,000 population by ethnic origin, sex and age group, 2006-2010 combined

Figure 4. Relative risk of Chlamydia notification, Chinese ethnic origin versus other ethnic origins, 2006-2010 combined

calculated the *Chlamydia* rates among those of Chinese and those of non-Chinese ethnicity for each age group by sex. In order to calculate population rates by ethnic origin, we used custom data from the 2006 Canadian Census. Population rates were calculated for all cases, and also stratified by age and sex. All calculations were done using Stata version 11.0, StataCorp LP, College Station, Texas.

Table 1. Rates and relative risk of *Chlamydia* infection by ethnicity among different age groups, Vancouver and Richmond, Canada, 2006-2010

Age group (years)	Sex	Chinese rate*	Non-Chinese rate*	Relative risk (RR)	95% CI for RR	p value
10-19	Female	176.9	729.2	0.25	0.21-0.29	<0.01
	Male	32.5	144.9	0.22	0.16-0.32	<0.01
	Subtotal	103.4	429.1	0.24	0.21-0.28	<0.01
20-29	Female	771.6	1261	0.61	0.57-0.66	<0.01
	Male	343.0	753.9	0.45	0.41-0.51	<0.01
	Subtotal	561.8	1012	0.55	0.52-0.59	<0.01
30-39	Female	498.5	350.9	1.42	1.28-1.57	<0.01
	Male	263.5	367.2	0.72	0.62-0.82	<0.01
	Subtotal	392.1	359.1	1.09	1.01-1.18	0.03
40-49	Female	302.5	108.7	2.78	2.39-3.24	<0.01
	Male	175.4	206.1	0.85	0.73-1.00	0.05
	Subtotal	245.2	158.1	1.55	1.40-1.72	<0.01
50-59	Female	118.5	25.2	4.70	3.43-6.44	<0.01
	Male	86.1	85.7	1.01	0.78-1.29	1.00
	Subtotal	103.1	54.9	1.88	1.56-2.25	<0.01
60+	Female	15.1	3.63	4.16	1.96-8.83	<0.01
	Male	20.5	23.7	0.87	0.54-1.40	0.63
	Subtotal	17.6	12.8	1.37	0.94-2.01	0.11
Total	Female	310.3	391.4	0.79	0.76-0.83	<0.01
	Male	153.0	282.6	0.54	0.51-0.58	0.63
	Subtotal	236.0	337.9	0.70	0.67-0.73	<0.01

* Rate is per 100,000 population per year.
CI = Confidence interval.

Chi square analysis was used to compare rates. Relative risks (RRs) and 95% confidence intervals (CIs) were calculated.

RESULTS

There were 15,012 cases of *Chlamydia* reported for Vancouver and Richmond over the period 2006-2010 (Figure 1). A total of 12,842 cases were confirmed Vancouver and Richmond cases. We dropped 273 cases because of repeat testing within 90 days, and 4 cases because of age less than 10 years, leaving 12,565 cases for analysis. The mean age of all cases was 29.4 years, and the median was 27 years. Of all the cases, 7,740 (61.6%) were female (Figure 2). The overall rate of *Chlamydia* was 276 per 100,000 population per year. The rate among males and females was 215 and 314 per 100,000, respectively. The total number of cases in Chinese was 3,361 and in non-Chinese was 9,194, for a population rate of 236 and 338 cases per 100,000 respectively ($p < 0.01$). Figure 3 depicts *Chlamydia* rates among females and males, broken down by age group and ethnicity.

The overall RR of *Chlamydia* infection by Chinese versus non-Chinese ethnicity was 0.70 (95% CI 0.67-0.73) (Table 1). Among females aged 20-29, Chinese rates were significantly lower than non-Chinese rates (RR 0.61, 95% CI 0.57-0.66). However, among females aged 30-39, there was a higher rate of *Chlamydia* infection for Chinese as compared with non-Chinese (RR 1.42, 95% CI 1.28-1.57). The RR increased in each successive decade of life, with a slight drop-off in those aged 60 and above. Among males the RR for Chinese was lower than or the same as for non-Chinese (Table 1). Figure 4 shows the RR broken down by age group for females and males.

DISCUSSION

The overall rate of *Chlamydia* was found to be 276 per 100,000 population per year during the period 2006-2010 in Vancouver and Richmond, Canada. The overall Canadian rate of *Chlamydia* in 2007 was 224 per 100,000 population.¹ The US rate of *Chlamydia* in 2009 was 409.2 per 100,000 population.¹⁰ Thus, the overall rate of

Chlamydia in Vancouver and Richmond was comparable with the overall Canadian rate and much lower than the US rate. Consistent with Canadian data, the overall rate among females was higher than that among males. This was likely due to increased testing for females, as females seek health care more often than men and are also likely to undergo screening for STIs during routine PAP tests. The peak age of infection was 20-29, again consistent with Canadian data. Overall, rates of *Chlamydia* in Vancouver and Richmond have held constant over the last five years.¹¹

We looked at *Chlamydia* rates by Chinese and non-Chinese ethnicity. The overall rate in the Chinese population was 236 per 100,000 population, compared with a rate of 338 per 100,000 population in the non-Chinese population, a statistically significant difference. With the exception of the two youngest age groups (age 10-19 and 20-29), the rates among Chinese females were all significantly higher than among non-Chinese females. Among males, rates were in general lower among Chinese than among non-Chinese men, except in the 50-59 age group.

The question of why female *Chlamydia* rates in older age groups were significantly higher among Chinese Canadians than among other Canadians is an important question to answer. There may be several reasons for this. First, the health-care-seeking behaviours of Chinese women may be different from those of non-Chinese women, leading to increased testing among the former. This is unlikely given the results of studies done in the US, Australia and Canada, which consistently show Chinese immigrant women to be less likely than the general population to undergo cervical cancer screening (and hence STI testing, since STI testing is often done with cervical cancer screening).¹²⁻¹⁴

Second, it may be that poor socio-economic conditions are facilitating transmission. However, a systematic review of risk factors for *Chlamydia* infection in developed nations found that socio-economic status (SES) was not associated with *Chlamydia* in multivariate analysis using any of the usual measures for SES.¹⁵ For our analysis, we were unable to reliably use aggregate SES indicators, and no data on individual SES were available.

The third reason may be that there are some cultural and socio-economic realities, as yet to be defined, in the ethnic Chinese population in Vancouver and Richmond. One estimate puts the overall prevalence of *Chlamydia* infection in China at 2,600 per 100,000 population.¹⁶ Up to 42% of *Chlamydia* urethral infections in men¹⁷ and 50% of *Chlamydia* cervical infections in women¹⁸ are asymptomatic. The average duration of infection of untreated *Chlamydia* is unknown, but one retrospective study has indicated that the majority of infections (95%) clear within four years.¹⁹ Thus, the incidence of *Chlamydia* in China would be at least 650 per 100,000 population per year, over twice the observed overall rate in Vancouver and Richmond. Because the main source country of immigration in Vancouver and Richmond is China, it follows that many of the infections in Chinese women may be imported. Many of the immigrants from China maintain significant business and cultural ties with China. Although no data are available to corroborate this, anecdotally it is known that many married Chinese men and women travel back and forth from China. It is conceivable that married Chinese men, in particular, may acquire *Chlamydia* infections from abroad.

Another reason for the increased rates may be that there was a sexual network in the Chinese community in Vancouver and

Richmond that facilitated transmission. This is supported by the work of Remple et al., who showed that many high-risk clients created sexual bridges between commercial sex establishments in Vancouver, many of which are staffed by Asian sex workers.²⁰ Research has shown that there are different normative socio-cultural expectations of men in Chinese society, including the view that having multiple sexual partners is desirable.²¹ This includes the acceptability of paying for sex among older Chinese. There is also a reluctance in China to discuss sexual matters, which extends to a lack of sex education in schools. This may result in less knowledge among Chinese immigrants about STIs. Further research is needed to elucidate the reasons behind our findings.

The fact that Chinese women had lower rates in younger age groups as compared with the general population deserves mention. The reasons for this are unclear and may be related to different rates of screening or to a true difference in infection rates.

Rates of *Chlamydia* among Chinese men also deserve mention. These were higher than among non-Chinese men only in the age group of 50-59 years. There can be a couple of reasons for this. First, Chinese men, if one of our postulates holds true, may be tested and treated overseas; or, second, Chinese men may be less likely than men of other ethnicities to seek health care.

Our study is supported by a strong surveillance system. *Chlamydia* reporting in BC is reportable under the provincial health act and is quite strong. In Vancouver and Richmond, laboratories report to the BCCDC.²² Individual tests done by the laboratories have a specificity of 99% or greater, and positive tests are always verified by running the test a second time. Thus false positives are minimal. Our algorithm is more likely to undercount Chinese names and result in a lower number. To avoid overcounting the Chinese cases, we classified any ambiguous names as "non-Chinese." Thus, although misclassification bias could be present, it would be biased to the null hypothesis and would not affect our conclusion that Chinese females are over-represented in the *Chlamydia* case counts.

There are limitations to our study. Although specificity for the tests used by laboratories is excellent, sensitivity for these tests is only approximately 80%-93%.⁷ Thus, false negatives may be present, and cases may have been undercounted. However, this would be a non-differential bias. Moreover, *Chlamydia* testing depends on multiple factors, including health care seeking behaviour and whether cases are symptomatic or not. Although young women who come in for cervical cancer screening are also most often screened for STIs, screening of older women for STIs may not be consistent among physicians. Current Canadian guidelines suggest STI screening for women with risk factors,⁶ age less than 25 being one risk factor. Screening may be sporadic for older women, especially Chinese women whom many physicians do not consider to be at risk of STIs. If this were the case, the true rates would be even higher and would not affect our conclusion. Another limitation is that only 2006 Census data were available to determine the population of ethnic origin. In the past several years, increasing numbers of immigrants have moved into Vancouver and Richmond. Thus, population demographic data may have changed, and population rates by ethnicity may be overestimated or underestimated. Finally, for population averages, we used population estimates from BC Stats. Because census data was only available for 2006, we decided to use estimates from BC Stats as the

denominator for the calculation of population rates. There may be some inconsistencies because two different data sets were used for the calculation of *Chlamydia* rates, but these differences should be minor and should not affect our overall conclusion.

In summary, the overall rate of *Chlamydia* was found to be 276 per 100,000 during the period 2006-2010 in Vancouver and Richmond. This rate is not much different from the Canadian rate of 236 per 100,000 during the same period. The overall *Chlamydia* rates among Chinese women were lower than among non-Chinese women in Vancouver and Richmond. However, rates among older Chinese women were much higher than those among non-Chinese ethnicity in the same age group. Future directions for research would be to compare rates with those of other Canadian cities with large ethnic Chinese populations to see whether this is a phenomenon in Vancouver and Richmond only or whether other Chinese-Canadians populations are also showing it. If this phenomenon occurs only in the Chinese population in Vancouver and Richmond, it is important to 1) determine the cause of it and 2) implement culturally appropriate STI prevention programs to decrease the rate of *Chlamydia* infection. Thus, future research should also focus on an ascertainment of risk factors for *Chlamydia* infection in Chinese women. Subject to further research in similar communities, our results suggest that physicians practising in areas with a high concentration of ethnic Chinese immigrants should consider STI screening, even for older Chinese women.

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Received: July 9, 2013

Accepted: February 11, 2014

RÉSUMÉ

OBJECTIFS : Comparer les taux d'infection à *Chlamydia trachomatis* des personnes d'ethnicité chinoise et non chinoise vivant dans des centres urbains du Canada.

MÉTHODE : Nous avons examiné les taux de *Chlamydia* chez les résidents de Vancouver et de Richmond, au Canada, selon l'ethnicité chinoise et non chinoise, entre 2006 et 2010. Nous avons stratifié les cas par groupe d'âge, par sexe et par ethnicité. Nous avons analysé 12 555 cas de *Chlamydia* survenus entre 2006 et 2010.

RÉSULTATS : Le taux global de *Chlamydia* était de 276 p. 100 000 par année. Les taux étaient de 236 p. 100 000 chez les personnes d'ethnicité chinoise et de 338 p. 100 000 chez les non-Chinois. Malgré les taux inférieurs pour l'ensemble des sujets d'ethnicité chinoise, les taux des femmes chinoises âgées étaient significativement plus élevés que ceux des femmes non chinoises du même âge.

CONCLUSIONS : Les médecins qui ont des patients d'ethnicité chinoise devraient savoir que les taux de *Chlamydia* chez les Sino-Canadiens sont importants, que ces taux sont plus élevés chez les Chinoises âgées que chez les femmes non chinoises, et qu'il faut en tenir compte lors du dépistage des infections transmissibles sexuellement dans cette population. Il faudrait pousser la recherche pour élucider les raisons de ces différences.

MOTS CLÉS : *Chlamydia*; Chinois; immigrants; infections transmissibles sexuellement