Prevalence of Chlamydia trachomatis and herpes simplex virus type 2: Results from the 2009 to 2011 Canadian Health Measures Survey

by Michelle Rotermann, Kellie A. Langlois, Alberto Severini and Stephanie Totten

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.
.. not available for any reference period
... not available for a specific reference period
... not applicable
0 true zero or a value rounded to zero
0 value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
p preliminary
r revised
x suppressed to meet the confidentiality requirements of the Statistics Act
e use with caution
F too unreliable to be published
* significantly different from reference category (p < 0.05)
Prevalence of **Chlamydia trachomatis** and herpes simplex virus type 2: Results from the 2009 to 2011 Canadian Health Measures Survey

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**Abstract**

**Background**

Chlamydia, caused by *Chlamydia trachomatis*, and genital herpes, caused by simplex virus type 2 (HSV-2), are common sexually transmitted infections. Their prevalence has been estimated in selected populations, but overall prevalence in Canada is not known.

**Data and methods**

Data are from the 2009 to 2011 Canadian Health Measures Survey. Socio-demographic, health and lifestyle information was obtained via a household questionnaire; blood and urine collected at a mobile examination centre were used to identify the presence of *Chlamydia trachomatis* and HSV-2 among 14- to 59-year-olds.

**Results**

An estimated 13.6% of Canadians (2.9 million) tested positive for HSV-2, and another 0.7% (158,000), for chlamydia. HSV-2 affects higher percentages of women than men, and individuals aged 35 to 59 versus 15 to 34. No significant differences in HSV-2 prevalence were detected by marital status, household income, education, or racial background. Nearly all individuals with laboratory-confirmed chlamydia or HSV-2 were unaware that they were infected.

**Interpretation**

This study is the first in Canada to report laboratory-confirmed prevalence of chlamydia and HSV-2 using a nationally representative sample. Results suggest that most infected people are unaware of their status.

**Keywords**

Disease notification, health surveys, sexually transmitted diseases

**Authors**

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Information about the prevalence of sexually transmitted infections (STIs) in Canada tends to be limited—not all STIs are notifiable1; under-reporting may occur2,3; and because of selection bias, generalizability is restricted.4 And even for nationally notifiable infections, data derived from routine surveillance capture only cases that are diagnosed and reported to public health authorities.

Chlamydia is the most commonly reported notifiable infection in Canada.5 Data are available from surveillance of cases identified through voluntary testing,5 and from targeted studies of specific populations and geographies.6,7 But because many chlamydia infections are asymptomatic, some cases go undiagnosed and untreated.1

For herpes simplex virus type 2 (HSV-2), the most frequent cause of genital herpes,8,9 official national statistics are not maintained.1 Prevalence information has largely been based on targeted studies of specific populations,10-14 and administrative health service or laboratory data.15-19 HSV-2 infections are frequently asymptomatic, or may have atypical presentations, and as a result, affected individuals may not seek testing and treatment.1

Chlamydia and HSV-2 are spread primarily by intimate physical contact, usually sexual intercourse, with an infected partner. Infection with one STI can increase the risk of contracting others, including the human immunodeficiency virus (HIV).18-20 Re-infection with chlamydia is common after repeated exposure (for example, unprotected sexual activity with an infected partner).1 Untreated infections can cause gynecological and reproductive complications21-23 and may adversely affect the health of infants exposed during childbirth.24-28
Methods

Data source

The data are from cycle 2 of the CHMS, which took place from August 2009 through November 2011. Information was collected at 18 locations across the country from respondents aged 3 to 79 living in private households. Residents of Indian Reserves, institutions and some remote regions, and full-time members of the Canadian Forces were excluded. The sample represents more than 96% of the population. Ethics approval for the survey was obtained from Health Canada’s Research Ethics Board. Detailed information about the content and sample design of the CHMS is available elsewhere.

In addition to an in-person interview to gather socio-demographic, health and lifestyle information, the survey involved a subsequent visit to a mobile examination center for direct physical measures, including blood and urine collection. Respondents unable to visit the centre could opt to have their direct measures taken at home.

Of the households selected, 75.9% agreed to participate, and 88.5% of selected household members aged 14 to 59 completed the household questionnaire. A total of 3,329 respondents (82.1% of those who responded to the household questionnaire) completed the mobile examination centre component. The final response rate for 14- to 59-year-olds, after adjusting for the sampling strategy, was 54.6%.

Many infectious diseases, if identified during clinical practice, must be reported to health authorities. Positive results from CHMS testing for chlamydia are reportable, yet are protected by the confidentiality provisions of the Statistics Act. The CHMS respected these competing requirements by asking respondents, before they were tested, for permission to share positive test results with health authorities.

Respondents were excluded from this study if:
- They were aged 3 to 13 (n=1,978) or aged 60 or older (n=1,098), and therefore, ineligible for testing.
- Blood was not collected for medical reasons, such as hemophilia or receipt of chemotherapy in the past 4 weeks (n<10).
- Conditions and circumstances, such as being in a wheelchair or having a catheter, prevented urine collection (n<10).
- The test(s) was (were) not performed because the respondent did not consent to disclosure (n=27); results were indeterminate (n<10); or samples were unavailable or insufficient (HSV-2: n=42; chlamydia: n=44).

The HSV-2 and chlamydia estimates in this article are based, respectively, on 3,247 and 3,250 respondents aged 14 to 59.

Urine and blood collection

First-catch urine for chlamydia testing was collected in 120 ml containers during the mobile examination centre visit. About half of the urine specimens were collected in accordance with the chlamydia testing protocol—that is, at least two hours after respondents’ most recent urination; the other half were collected from respondents who had urinated more recently. No statistically significant differences in chlamydia prevalence were found between samples collected in compliance with the two-hour voiding interval and those that were not (data not shown).

At the mobile examination centre, blood was collected by venipuncture into vacutainers. The pooled serum was processed for HSV-2 in addition to other virus biomarkers.

Infection markers

Chlamydia

Urine samples from respondents aged 14 to 59 were frozen within four hours of collection and tested for Chlamydia trachomatis with the Roche Amplicor® detection kit, a PCR-based method that targets the chlamydia cryptic plasmid. According to the manufacturer, sensitivity and specificity for this test are 96.8% and 94.3%, respectively, compared with culture isolation. A positive result indicates prevalent infection with Chlamydia trachomatis.

Herpes simplex virus type 2

Serum from the blood collected from respondents aged 14 to 59 was analysed using the HerpeSelect® ELISA IgG assay (Focus Diagnostics) to screen for HSV-2 antibodies, with 1.10 as the cut-off “index” value for positivity, as recommended by the manufacturer. This assay uses the HSV-2 glycoprotein G as the type-specific antigen and can discriminate between herpes simplex virus types 1 and 2 antibodies. Specimens with index values in the inconclusive range (0.90 to 1.10) were retested. Values exceeding 1.10 indicate life-long infection, latent or symptomatic, with HSV-2. Fewer than 10 cases had inconclusive test results and were excluded from the analysis. According to the manufacturer, the test’s sensitivity and specificity among sexually active adults are 96.1% and 97.0%, respectively, and are in agreement with published studies using Western blot, which is the gold standard.

Covariates

Age group, sex, household income, education, marital status, racial background, and previous diagnosis of a sexually transmitted infection were examined in association with HSV-2. Three age groups were specified: 14 to 34, 35 to 49, and 50 to 59.

were shipped weekly and processed by the National Microbiology Laboratory in Winnipeg, Manitoba according to the manufacturers’ instructions.
Household income, adjusted for household size, was classified into two categories: higher and lower. Households were considered to be lower income if their total earnings in the past year were less than $30,000 (one or two members), less than $40,000 (three or four members), or less than $60,000 (five or more members). Income was imputed for fewer than 20% of the overall sample; details are available elsewhere.29

Education was dichotomized as less than postsecondary graduation and postsecondary graduation. For 14- to 24-year-olds, the highest level of education in the household was used.

Marital status was assessed using the following categories: never married, married, living with a partner, separated, divorced, and widowed. For this analysis, those who were never married, separated, divorced or widowed were grouped as “unmarried” to represent the population more likely to initiate new sexual relationships. Those who were married or living with a partner were classified as “married/cohabiting” to represent those less likely to initiate new sexual relationships.

Respondents could choose from an extensive list of racial backgrounds, with individuals indicating “White” being classified as such, and all others combined into “non-White.”

Respondents were asked if they had ever been diagnosed with a sexually transmitted infection, and if so, which one(s). They could report more than one(s). Blood and urine collected during the household interview, CHMS respondents were asked if they had ever been diagnosed with an STI, and if so, which one(s). Blood and urine collected at the mobile examination centre were tested to cross-validate these results.

No respondents who tested positive for chlamydia reported ever having been diagnosed with an STI (data not shown). Among those who tested positive for HSV-2, 6% reported having been diagnosed with the infection; 94% were unaware that they were infected (Table 2).

In general, awareness of infection did not differ significantly by age group or sex, although it tended to increase with age.

### Results

#### Chlamydia

According to the 2009 to 2011 CHMS, the overall prevalence of Chlamydia trachomatis infection in the urine of 14- to 59-year-olds was 0.7% (95% confidence interval 0.4% to 1.3%) (a weighted estimate of 158,000 individuals) (data not shown). Because of sample size constraints, further analyses were not conducted.

#### Herpes simplex virus type 2

The seroprevalence of HSV-2 type-specific antibodies among people aged 14 to 59 was 13.6% (an estimated 2.9 million) (Table 1). The overall seroprevalence of HSV-2 was higher among females than males (16.1% versus 11.0%); this difference was most apparent among younger people, postsecondary graduates, and individuals who reported their racial background to be White. The prevalence of infection rose from around 6% at ages 14 to 34 to about 19% among people aged 35 or older. No differences were found by marital status, household income, education, or racial background.

### Most unaware of infection

During the household interview, CHMS respondents were asked if they had ever been diagnosed with an STI, and if so, which one(s). Blood and urine collected at the mobile examination centre were tested to cross-validate these results.

No respondents who tested positive for chlamydia reported ever having been diagnosed with an STI (data not shown). Among those who tested positive for HSV-2, 6% reported having been diagnosed with the infection; 94% were unaware that they were infected (Table 2).

In general, awareness of infection did not differ significantly by age group or sex, although it tended to increase with age.

### Table 1

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total 14 to 59</th>
<th>% to from</th>
<th>% to from</th>
<th>% to from</th>
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<td>16.4</td>
<td>11.0</td>
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<tr>
<td>14 to 34†</td>
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<td>26.9</td>
<td>16.0†</td>
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<td>17.8†</td>
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<td>18.8</td>
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<td>10.7</td>
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<td>10.3</td>
<td>19.3</td>
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<tr>
<td>White‡</td>
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<td>10.3</td>
<td>15.6</td>
<td>9.9</td>
</tr>
<tr>
<td>Non-White†</td>
<td>16.2†</td>
<td>10.4</td>
<td>24.3</td>
<td>14.5†</td>
</tr>
</tbody>
</table>

† reference category
* significantly different from reference category (p < 0.05)
† significantly different from male (p < 0.05)
‡ use with caution
... not applicable

Note: If coefficient of variation of estimate exceeds 33.3%, estimate is indicated as being less than upper limit of 95% confidence interval.

Discussion

The present study is the first to analyze the prevalence of chlamydia and HSV-2 based on direct measures of a nationally representative sample of age-eligible Canadians. The 2009 to 2011 CHMS results are comparable to those of the National Health and Nutrition Examination Survey (NHANES) in the United States, the Australian Diabetes, Obesity and Lifestyle Study (AusDiab) in Australia, and the National Survey of Sexual Attitudes and Lifestyles (Natsal) in Britain. For instance, based on the 2005 to 2008 NHANES, the seroprevalence estimate for HSV-2 among 14- to 49-year-olds was 16.2%, 38 and the 2007 to 2008 chlamydia prevalence among 14- to 39-year-olds was 1.6%. 39 AusDiab (1999 to 2000) reported an HSV-2 prevalence of 12% among Australians aged 25 or older. 40 Natsal’s chlamydia prevalence was estimated at 2.2% for men and 1.5% for women. 41

Similar to CHMS results, HSV-2 seroprevalences in NHANES and AusDiab tended to be higher among older than younger age groups, and higher among females than males. 38-40,42-44 However, contrary to the NHANES or AusDiab analyses, and likely because of limited statistical power, CHMS HSV-2 seroprevalence estimates did not differ by marital status 42-44 or socio-economic status. 42

Few, if any, CHMS respondents who were positive for chlamydia or HSV-2 were aware of it. This is consistent with other research. For example, 85.7% of Americans who were sero-positive for HSV-2 did not know they were infected, 44 and high percentages with chlamydia were undiagnosed. 41 Lack of symptoms may be a reason why many people who are positive for HSV-2 or chlamydia do not know that they are infected. 45,46

Limitations

Logistical and budget constraints affected the number of CHMS collection sites and the overall sample size. 29 As a result, it was sometimes necessary to use more general variable definitions than would have been preferable for this analysis. Sample size limited elaboration of influential factors such as geography, Aboriginal identity, and sexual orientation, and may have reduced the ability to identify statistical significance.

The CHMS excludes some populations at potentially high-risk for STIs, such as people who are homeless. 1 Herpes simplex virus type 1 (HSV1) is becoming an important cause of genital herpes, accounting for an estimated 40% of genital infections in Canada, 17 and at least half of such infections in other developed countries. 40,47,48 Because the CHMS screened only for HSV-2, infections caused by HSV1 will be missed, which may be particularly important at younger ages. 16,17

The overall response rate to the CHMS for 14- to 59-year-olds was 54.6%. Survey weights ensured that the sample is representative of the target population, but bias may exist if the infection status of non-respondents differed systematically from that of participants.

The CHMS used a combination of self-reported, clinic, and laboratory data. While self-reported data are subject to social desirability and recall biases, laboratory data are also imperfect. Deviation from specimen collection and storage protocols can compromise test results, 29 and nearly all directly measured tests fail to correctly identify some percentage of true positives and negatives. 32

Table 2

Percentage unaware of infection status among those with lab-confirmed herpes simplex virus type 2, by age group and sex, household population aged 14 to 59, Canada, 2009 to 2011

<table>
<thead>
<tr>
<th>Age group</th>
<th>Total</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td>95% conf. interval</td>
<td>95% conf. interval</td>
<td>95% conf. interval</td>
</tr>
<tr>
<td>Total 14 to 59</td>
<td>94.0</td>
<td>88.1</td>
<td>97.1</td>
</tr>
<tr>
<td>14 to 34†</td>
<td>99.0</td>
<td>95.9</td>
<td>99.8</td>
</tr>
<tr>
<td>35 to 49</td>
<td>93.2</td>
<td>83.6</td>
<td>97.3</td>
</tr>
<tr>
<td>50 to 59</td>
<td>92.6</td>
<td>80.2</td>
<td>97.5</td>
</tr>
</tbody>
</table>

† reference category
* significantly different from reference category (p < 0.05)
13
Conclusion
The results of this analysis show that at ages 14 to 59, the prevalence of chlamydia is less than 1%, and that HSV-2 affects about 14% of the people in this age range. A comparison of laboratory-confirmed infections with self-reports of diagnoses suggests that almost all respondents testing positive for chlamydia or HSV-2 were unaware that they were infected. The estimates in this study serve as baseline data to track trends in prevalence. As additional waves of CHMS data become available, it may be possible to combine cycles to more fully investigate risk factors of laboratory-confirmed STIs, and potentially, to explore the health outcomes and health service use of those infected.

References


