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Original article

## Cumulative Risk of Chlamydial Infection Among Young Women in Florida, 2000–2011

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 A B S T R A C T

**Purpose:** *Chlamydia trachomatis* is a very common infection among young women in the United States; information on cumulative risk of infection is limited. We sought to estimate the cumulative risk of chlamydial infection for young women.

**Methods:** We measured cumulative risk of reported chlamydial infection for 14- to 34-year-old women in Florida between 2000 and 2011 using surveillance records and census estimates. We calculated reported infections per woman, analyzed first infections to get cumulative risk, and calculated risk of repeat infection over the 12-year period.

**Results:** There were 457,595 infections reported among 15- to 34-year-old women. Reports increased annually from 25,390 to 51,536. Nineteen-year-olds were at highest risk with 5.1 infections reported per 100 women in 2011. There were 341,671 different women infected. Among women aged 14–17 years in 2000, over 20% had at least one infection reported within 12 years, and among blacks, this risk was over 36%, and that underestimates risk because 18% of cases were missing race/ethnicity information. Repeat infections were common. Among 53,109 with chlamydia at the age of 15–20 years during 2000–2003, 36.7% had additional infections reported by 2011.

**Conclusions:** More than one out of five women in Florida was reported as having chlamydia during her young-adult years; risk was highest for black women. True infection risks were likely much higher because many infections were not diagnosed or reported. Young women who had chlamydia were very likely to get reinfected. Rates of infection remain high despite years of screening. More information is needed on how to prevent chlamydial infection.

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 IMPLICATIONS AND  
 CONTRIBUTION

The cumulative risk of chlamydia is extremely high for young women. Women who are infected once are likely to become reinfected. Diagnosing and treating infection can prevent progression to pelvic inflammatory disease (PID) and infertility. Treating partners reduces the risk of reinfection.

*Chlamydia trachomatis* is a common infection, yet there is little information on how many women have acquired it at some point during their young-adult years. In 2011, chlamydia accounted for 71.1% of all notifiable infections in the United States [1], although many infections may remain undetected because most are asymptomatic [2]. If left untreated, 10%–15% of

chlamydial infections will progress to symptomatic PID, and others will progress to asymptomatic PID [3,4]. After having developed symptomatic PID, an estimated 9% of women develop infertility [3,5]. Therefore, annual screening to detect asymptomatic infections and reduce the risk of PID [4,6] is recommended by the US Preventive Services Task Force (Grade A recommendation) for all sexually active women under the age of 25 years [7].

Surveillance data show that the number of chlamydial infections reported among women in the United States has increased every year since reporting was first required by all states in 2000 and reached a total of 1,018,552 cases in 2011 [8]. This total

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is the number of infections reported in 1 year and is higher than the number of women with an infection reported in 1 year because some women had multiple infections. Chlamydia prevalence has remained fairly stable in representative samples of 14- to 25-year-old women in the United States (4.1% in 1999–2000 and 3.8% in 2007–2008) [9]. Therefore, increases in reported cases are thought to represent increases in case detection due to increases in testing and the use of more sensitive tests, rather than true increases in prevalence [8,9]. These prevalence estimates can be projected to an estimated 660,000 chlamydial infections among 15- to 24-year-old women on one day in 2008 [10]. However, prevalence data do not tell us how many women had chlamydia at any time during that year or during the many years that comprise a woman's period of greatest risk (aged 15–24 years).

In Florida, reported sexually transmitted infections are maintained in a secure, name-based, electronic surveillance database. This database allows us to measure the number of infections reported, the number of unique women reported with infections, and the number of women with multiple infections. Using census population estimates as denominators, we can estimate the risk of being reported with chlamydia for women living in Florida each year and over the 12-year period from 2000 through 2011.

## Methods

Chlamydial infection has been reportable in Florida since 1993. Most reports to the health department come from laboratories. Duplicate case reports are removed by the county health departments or at the state level after confirmation of data completeness. We selected all cases reported among women in Florida starting in 2000, ending with cases diagnosed in 2011 and reported by March 19, 2012. Multiple infections from the same woman were considered separate infections if they were at least 30 days apart (to reduce multiple detections of the same infection). For denominators, we used census estimates by age, race, ethnicity, and year [11].

We first examined all reported infections for women by demographic characteristics and year of report. Infections per woman were calculated using the census estimates of the number of women of that age living in Florida. Race/ethnicity information was missing for a large fraction of cases, so we did subgroup analyses for the group with the most cases, black women, but not for other race/ethnicity groups because the number of reported cases was less than (or nearly equal to) the number of cases with missing race.

Next, we limited our analysis to the first infection that a woman had in the database (starting in 2000) in order to determine the number of women who had at least one infection. To estimate risks, we divided the number of first infections for women of a certain age by the census estimate for the number of women of that age living in Florida. Cumulative incidence of a first infection was estimated by adding risks calculated for women who were 1 year older for each year later (e.g., the risk of infection over 2 years for women who were aged 15 years in 2000 is equal to the risk of first infection for 15-year-olds in 2000 plus the risk of first infection for 16-year-olds in 2001).

Finally, we studied women with more than one reported infection. The time to the first-reported repeat infection was estimated using life-table analyses in SAS for women who were between 15 and 20 years old at the time of their first chlamydial infection in 2000–2003.

We did not calculate confidence intervals for our estimates or *p* values for our comparisons because we included all surveillance data from Florida, not a sample. Our numbers are very large, and most of our error would be expected to be due to variations in testing and reporting of chlamydia and not due to chance. Centers for Disease Control and Prevention staff did not have access to personal identifiers. Secondary analyses of routinely collected surveillance data do not involve human research and therefore do not require approval by the Centers for Disease Control and Prevention institutional review board.

## Results

Between January 1, 2000, and December 31, 2011, there were 457,595 infections reported among 15- to 34-year-old women living in Florida. During this time, the annual number of reported infections doubled, increasing from 25,390 to 51,536, with the biggest annual increase occurring in 2008 (7,860). After adjusting for increases in the population size, the overall risk of reported infection increased from 1.3 infections per 100 women (1.3%) in 2000 to 2.2 infections per 100 women (2.2%) in 2011. There was a peak in the risk of reported infection at the age of 18–22 years (Figure 1A); that 5-year age group accounted for 52% of the reported infections for 15- to 34-year-olds in 2011. The highest risk was seen among 19-year-olds. The risk of reported infections for 19-year-olds increased from 3.2% in 2000 to 5.1% in 2011 (a 2011:2000 risk ratio of 1.59). The annual increase in the risk of reported infections was smaller for the youngest women compared with older women. There was almost no increase in risk for 15-year-olds. The 2011:2000 risk ratio was 1.04 for 15-year-olds, 1.13 for 16-year-olds, 1.53 for 18-year-olds, and over 2.0 for women over the age of 24 years.

The race/ethnicity of the 457,595 cases was the following: black (46.0%), white (24.1%), Hispanic (11.1%), Asian (.3%), American Indian/Alaskan Native (.2%), and unknown (18.4%). Unknown race/ethnicity was less likely in 2000–2006 (13.6%) than in 2007–2011 (22.8%), was less likely when infections were diagnosed in health department clinics (13.1%) than at other sites (20.3%), and was less likely for women who had multiple infections (8.0%) than for women with one reported infection (21.9%). The annual number of reported infections per 100 black women aged 15–34 years increased from 3.0 in 2000 to 4.7 in 2010 before declining slightly to 4.3 in 2011. The highest number of infections by age and race was 10.3 infections per 100 black women aged 19 years in 2010 (Figure 1B).

The 457,595 reported infections occurred among 341,671 different women. To estimate the age at which women acquire their first reported chlamydial infection, we restricted our analysis to the first-reported infection for the women in our dataset. The age distribution of first reported infections was similar to the distribution shown in Figure 1 for all reported infections, with the peak at age 19. In 2011, 3.5% of 19-year-old women were reported with what was their first chlamydial infection in the database. The risk of having a first-reported chlamydial infection at a particular age was 1% or higher for women during each year of age between 15 and 25 years, and then this risk fell below 1% per year, decreasing to .31% of 34-year-old women. First-reported infections for black women peaked at age 18; 6.23% of all 18-year-old black women in 2011 had their first reported chlamydial infection. The annual number of black women with their first reported chlamydial infection declined from a peak of 12,745

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