# Epidemiological Analysis of Chlamydia and Gonorrhea Cases in La Crosse County, Wisconsin, 2001-2020

Abigail Multerer, MS; Paula Silha, MASL, MCHES; Gary D. Gilmore, PhD, MCHES; Jennifer Rombalski, MPH; Abdulaziz Elfessi, PhD; Loriann Stanislawski, MS, MCHES; Peter R. Wilker, PhD; William R. Schwan, PhD

## ABSTRACT

**Introduction:** *Chlamydia trachomatis* and *Neisseria gonorrhoeae* are the two most reported bacterial infections in the United States, with over 1.5 million and 500 000 cases reported in 2019, respectively. The number of infections continues to rise, with significant disparities at the national level in the rate of infection between age, race, and sex demographic classifications. Although the disparities in chlamydia and gonorrhea infections have been well described in the US, little research has been done on a smaller community scale, such as La Crosse County, Wisconsin.

**Methods:** We accessed data from La Crosse County, Wisconsin; the State of Wisconsin; and the United States for gonorrhea and chlamydia cases from 2001 through 2020 and completed both descriptive analysis and inferential statistical analysis.

**Results:** Gonorrhea and chlamydia rates have risen at the local, state, and national levels. Demographic analysis of the cases in La Crosse County conveyed that females and Black populations having higher rates of infection. Additionally, the 25- to 39-year age group had a marked increase in gonorrhea rates at the county and state levels.

**Conclusions:** We were able to show demographic differences in chlamydia and gonorrhea incidence rates. The authors recommend that the 25- to 39-year-old group should undergo more regular comprehensive screening for all sexually transmitted infections.

## INTRODUCTION

In the United States (US), an estimated 20 million people are newly diagnosed with a sexually transmitted infection (STI) each year.[1] Data in the US from 2019 showed *Chlamydia trachomatis* infection topping 1.5 million and over 500 000 cases of gonorrhea caused by *Neisseria gonorrhoeae*.[2,3] Both *C trachomatis* and *N gonorrhoeae* are transmitted by direct sexual contact.[4,5] However, 77% of individuals infected with *C trachomatis* and approximately half of the *N gonorrhoeae* infections will display no symptoms, so often these infections go undiagnosed.[5]

Approximately 50% of all new STIs diagnosed each year in the US are in those aged 15 to 24.[1,4] Twice as many young women within the 15- to 24-year age bracket will have a chlamydia diagnosis compared to young men in the same age bracket.[1] Because women have more complications arising from chlamydia and gonorrhea infection than men, the Centers for Disease Control and Prevention (CDC) recommends women be screened more regularly than men for both infections.[6]

Disparities in STI rates do exist among different racial groups, but this is largely due to variations in access to health care, segregated housing, and the number of sexual partners.[7,8] However, in a California study, Black Americans were shown to have 6 times higher STI rates than White Americans, even when income was taken into consideration. Of note, Black Americans within the highest poverty group had the most cases of gonorrhea in this study, demonstrating that socioeconomic status has a significant bearing on STI rates.[9] Although race itself does not indicate a

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**Author Affiliations:** Department of Microbiology, University of Wisconsin–La Crosse, La Crosse, Wisconsin (Multerer, Wilker, Schwan); La Crosse County Health Department, La Crosse, Wisconsin (Silha, Rombalski); Department of Public Health and Community Health Education and Graduate and Extended Learning, University of Wisconsin–La Crosse, La Crosse, Wisconsin (Gilmore); Department of Mathematics and Statistics, University of Wisconsin–La Crosse, La Crosse, Wisconsin (Elfessi); Wisconsin Department of Health and Human Services, Madison, Wisconsin (Stanislawski).

**Corresponding Author:** William R. Schwan, PhD, Department of Microbiology, University of Wisconsin–La Crosse, 1725 State St, La Crosse, WI 54601; phone 608.785.6980; email wschwan@uwlax.edu; ORCID ID 0000-0003-3076-1815

**Table 1.** Total Number of Annual Reported Cases and Incidence Rates, When Available, of *Chlamydia trachomatis* in La Crosse County, Wisconsin, and the US, 2001–2020

| Year | La Crosse County | | Wisconsin | | United States | |
|---|---|---|---|---|---|---|
| | Cases | Rate[a] | Cases | Rate[a] | Cases | Rate[a] |
| 2001 | 266 | 247 | 16 284 | 321 | 783 242 | 278 |
| 2002 | 281 | 259 | 17 000 | 312 | 834 555 | 297 |
| 2003 | 314 | 288 | 17 942 | 327 | 877 478 | 305 |
| 2004 | 396 | 362 | 19 217 | 349 | 929 462 | 320 |
| 2005 | 355 | 323 | 20 461 | 369 | 976 445 | 333 |
| 2006 | 353 | 319 | 20 190 | 362 | 1 030 911 | 348 |
| 2007 | 335 | 300 | 19 555 | 349 | 1 108 374 | 370 |
| 2008 | 369 | 327 | 20 996 | 372 | 1 210 523 | 401 |
| 2009 | 362 | 317 | 20 906 | 369 | 1 244 180 | 409 |
| 2010 | 364 | 317 | 23 236 | 408 | 1 307 893 | 426 |
| 2011 | 460 | 378 | 24 619 | 429 | 1 412 791 | 457 |
| 2012 | 389 | 337 | 23 726 | 414 | 1 422 976 | 457 |
| 2013 | 412 | 352 | 23 572 | 412 | 1 401 906 | 447 |
| 2014 | 486 | 416 | 23 154 | 406 | 1 441 789 | 456 |
| 2015 | 520 | 423 | 24 381 | 425 | 1 526 658 | 475 |
| 2016 | 524 | 469 | 26 894 | 470 | 1 598 354 | 495 |
| 2017 | 489 | 440 | 27 740 | 485 | 1 708 569 | 525 |
| 2018 | 539 | 476 | 26 797 | 490 | 1 595 559 | 538 |
| 2019 | 612 | 543 | 29 772 | 529 | 1 808 703 | 551 |
| 2020 | 598 | 495 | 22 277 | 378 | 1 335 916 | 403 |

[a]Incidence rate per 100 000 population.

**Table 2.** Total Number of Annual Reported Cases and Incidence Rates, When Available, of *Neisseria gonorrhoeae* in La Crosse County, Wisconsin, and the US, 2001–2020

| Year | La Crosse County | | Wisconsin | | United States | |
|---|---|---|---|---|---|---|
| | Cases | Rate[a] | Cases | Rate[a] | Cases | Rate[a] |
| 2001 | 55 | 51 | 6 011 | 111 | 361 705 | 129 |
| 2002 | 39 | 36 | 6 341 | 116 | 224 918 | 125 |
| 2003 | 19 | 17 | 5 663 | 103 | 335 104 | 116 |
| 2004 | 63 | 58 | 5 053 | 92 | 330 132 | 114 |
| 2005 | 46 | 42 | 5 869 | 106 | 339 593 | 116 |
| 2006 | 27 | 24 | 6 927 | 124 | 358 366 | 121 |
| 2007 | 62 | 55 | 6 752 | 120 | 355 991 | 119 |
| 2008 | 43 | 38 | 6 087 | 108 | 336 742 | 112 |
| 2009 | 61 | 53 | 5 201 | 92 | 301 174 | 99 |
| 2010 | 34 | 30 | 5 091 | 89 | 309 341 | 101 |
| 2011 | 54 | 45 | 4 789 | 84 | 321 849 | 104 |
| 2012 | 51 | 42 | 4 704 | 83 | 334 826 | 107 |
| 2013 | 25 | 22 | 4 599 | 81 | 333 004 | 106 |
| 2014 | 43 | 37 | 4 078 | 72 | 350 062 | 111 |
| 2015 | 54 | 43 | 5 260 | 93 | 395 216 | 123 |
| 2016 | 35 | 30 | 6 498 | 115 | 468 514 | 145 |
| 2017 | 48 | 44 | 7 661 | 135 | 555 608 | 171 |
| 2018 | 145 | 125 | 7 619 | 139 | 528 013 | 178 |
| 2019 | 87 | 77 | 9 054 | 161 | 616 392 | 188 |
| 2020 | 163 | 135 | 8 315 | 143 | 564 110 | 171 |

[a]Incidence rate per 100 000 population.

genetic predisposition to certain STIs like gonorrhea, lifestyle differences among certain races provide for a greater risk of STIs among those groups.[7-9]

In this study, chlamydia and gonorrhea rates were assessed in a smaller community and then compared to the State of Wisconsin and the US from 2001 through 2020. The relationship between age, sex, and race was assessed in relation to positive chlamydia or gonorrhea infection in La Crosse County compared to the State of Wisconsin and the US from 2001through 2020.

## METHODS

### Data Collection

All laboratory detected incident cases of *C trachomatis* and *N gonorrhoeae* in La Crosse County per year during 2001-2020 were collected from the La Crosse County Health Department. The total number of incident laboratory detected positive cases and cases per 100 000 for *C trachomatis* and *N gonorrhoeae* in Wisconsin and the US that represented the years 2001-2020 were collected from the CDC Nationally Notifiable Infectious Diseases and Conditions, United States: Weekly Tables.[10] This study was approved by the Institutional Research Board committee at the University of Wisconsin–La Crosse.

Because of a software change in the State of Wisconsin in 2012, demographic numbers for chlamydia and gonorrhea incidence rates in La Crosse County and Wisconsin before 2012 were unretrievable. All positive cases from 2012 through 2019 were reported by age, sex, and race for La Crosse County and the State of Wisconsin by using data collected from the Wisconsin Department of Health Services Sexually Transmitted Disease Surveillance Annual Reports.[11] The total number of chlamydia and gonorrhea cases, as well as rates per 100 000, were differentiated by sex and race for the US using data accessed from the CDC and the State of Wisconsin.[10,11] Cases with missing characterization of age, sex, and race were excluded from analysis. Age statistics for the US were not computed because of age breakdown data discrepancies with La Crosse County and the State of Wisconsin. For gonorrhea and chlamydia cases in La Crosse County and Wisconsin, the following age groups were used: 0 to 14, 15 to 24, 25 to 39, and ≥40.[11]

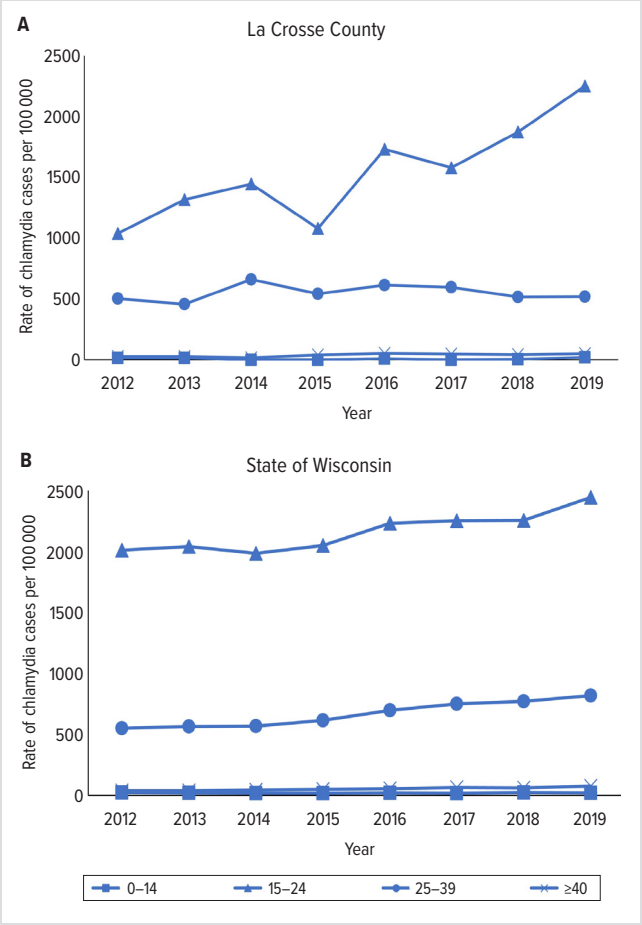
### Descriptive Analysis

The total annual number of reported incident chlamydia and gonorrhea infections for La Crosse County, the State of Wisconsin, and the US, as well as the rates per 100 000 population, when available, were organized into tables. The annual rate of incident chlamydia and gonorrhea infections per 100 000 population in La Crosse County, the State of Wisconsin, and the US were graphed from 2011 through 2019.

#### *Inferential Statistical Analysis*

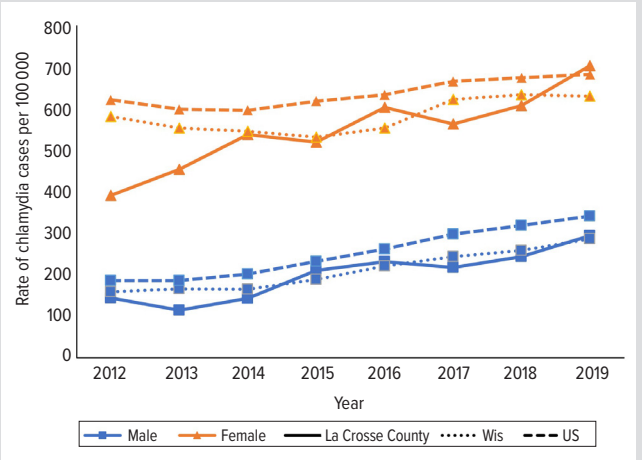
An analysis of variance with 2 categorical independent variables (2-way ANOVA) was performed for each demographic category (age, sex, and race) and location for both chlamydia and gonorrhea, followed by a Bonferroni post-hoc test when needed

**Figure 1.** Annual Incidence Rates of Chlamydia Infections per 100 000 Population for Those Aged 0–14, 15–24, 25–39, and ≥40 Years Old in (A) La Crosse County and (B) the State of Wisconsin, 2012–2019




Data were collected from the Centers for Disease Control and Prevention Annual Morbidity and Mortality Reports and the Wisconsin Department of Health Services Sexually Transmitted Diseases Surveillance Reports.

**Figure 2.** Annual Incidence Rates of Chlamydia Infections per 100 000 Population for Males and Females in La Crosse County, the State of Wisconsin, and the United States, 2012–2019




Data were collected from the Centers for Disease Control and Prevention Annual Morbidity and Mortality Reports and the Wisconsin Department of Health Services Sexually Transmitted Diseases Surveillance Reports.

to reduce false-positive results[12] using SPSS Statistics version 28.0.0.0 (IBM Corp). A *P* value of ≤0.05 was deemed significant.

## RESULTS

We sought to analyze the relationship between age, sex, and race and positive *C trachomatis* and *N gonorrhoeae* infection in La Crosse County compared to the State of Wisconsin and the US during 2001-2020, and we found that the total number of annual incident cases of chlamydia and gonorrhea in La Crosse County, Wisconsin, and the US steadily rose during this time period (Tables 1 and 2), with an approximate doubling of chlamydia cases per 100 000.

### Chlamydia Rates

#### *Incidence by Age Group*

Age-related data regarding the rate of chlamydia infection per 100 000 population were collected for individuals in 4 different age groups (0-14, 15-24, 25-39, and ≥40 years old) in La Crosse County and the State of Wisconsin. Chlamydia infections were highest in the 15- to 24-year-old age group in both the county (Figure 1A) and state (Figure 1B) and increased over the study period. Age-related data for the US from 2012 through 2019 were not included due to differences in age groupings at the national level versus the county and the state.

To further analyze the relationship between the rate of chlamydia infection and age group, a 2-way ANOVA F test showed a significant difference ($P<0.001$) in the average incidence rates within the 4 age groups in both the county and state. A Bonferroni post-hoc test analysis showed the average incidence rate of chlamydia infection during 2012-2019 among those aged 0 to 14 in La Crosse County was significantly lower ($P<0.001$) than those aged 15 to 24, with no significant differences among those aged 0 to 14 ($P=0.874$), 25 to 39 ($P=0.160$), and ≥40 years old ($P=0.847$). Similar findings also were observed when comparing the age groups within the state.

Next, average incidence rates of chlamydia infection by age group within each location were reviewed. The average incidence rate of chlamydia infection during 2012-2019 in both La Crosse County and the State of Wisconsin in those aged 0 to 14 and ≥40 years old were not significantly different ($P=1.000$). However, those aged 15 to 24 ($P<0.001$) and 25 to 39 years old ($P<0.001$) had significantly higher rates both in the county and the state compared to other age groups.

#### *Incidence by Sex*

The rates of chlamydia infection per 100 000 population in La Crosse County, the State of Wisconsin, and the US were analyzed for 2012-2019 to compare male and female rates. Infection rates were significantly higher in females versus males at all levels ($P=0.009$, Figure 2). Male and female chlamydia incidence rates rose steadily at the county, state, and national levels from

2012 through 2019, but no significant difference was observed ($P < 0.643$) when reviewing the relationship between location and sex.

### *Incidence by Race*

Next, rates of chlamydia infection per 100 000 population were collected for White, Black, Native American/Alaskan Native, and Asian/Pacific Islander individuals in La Crosse County, the State of Wisconsin, and the US from 2012 through 2019. Black and Native American/Alaskan Native individuals demonstrated significantly higher chlamydia infection rates ($P < 0.001$) than the other races (Figure 3). La Crosse County and State of Wisconsin data showed Black individuals had a higher infection rate at the national level. Native American/Alaskan Native individuals in La Crosse County displayed higher chlamydia infection rates in 2012 and 2014-2016 compared to the rates in Wisconsin and the US.

No significant differences for White or Asian/Pacific Islander individuals at the county ($P = 1.000$), state ($P = 0.8660$, and national levels ($P = 0.400$) were detected. However, the chlamydia infection rate in the Black population was significantly higher in both La Crosse County ($P < 0.001$) and the State of Wisconsin ($P < 0.001$) versus the US, but no significant difference in chlamydia rates was noted for Black individuals between the county and the state ($P = 0.202$). Chlamydia rates were significantly higher in La Crosse County than the State of Wisconsin ($P = 0.037$) or the US ($P < 0.001$) for Native American/Alaskan Native individuals, but there was no significant difference between the State of Wisconsin and the US ($P = 0.433$) among this population.

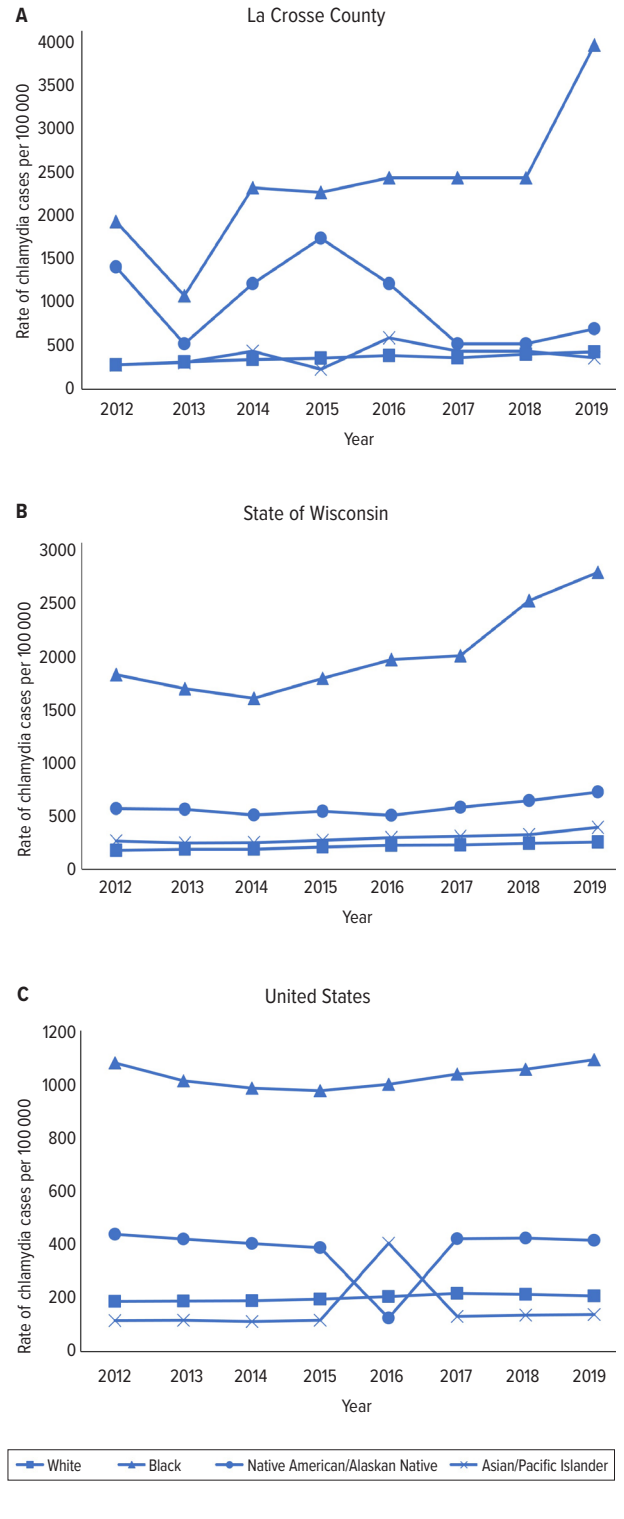
Next, Bonferroni post-hoc analysis of the 2012-2019 data in La Crosse County indicated significantly fewer chlamydia cases ($P < 0.001$) in White or Asian/Pacific Islander populations than Black or Native American/Alaskan Native populations, but no significant difference was observed for White versus Asian/Pacific Islander ($P = 1.000$) populations. However, the chlamydia rate was significantly higher ($P < 0.001$) in the Black population versus the Native American/Alaskan Native population in La Crosse County. Similarly, the State of Wisconsin and the US had significantly higher ($P < 0.001$) average chlamydia rates among Black individuals compared to all other groups. Both Wisconsin and the US had chlamydia infection rates ($P = 0.087$ to $P = 1.000$) that were not significant when Native American/Alaskan Native, Asian/Pacific Islander, and White populations were compared.

## Gonorrhea Rates

### *Incidence by Age Group*

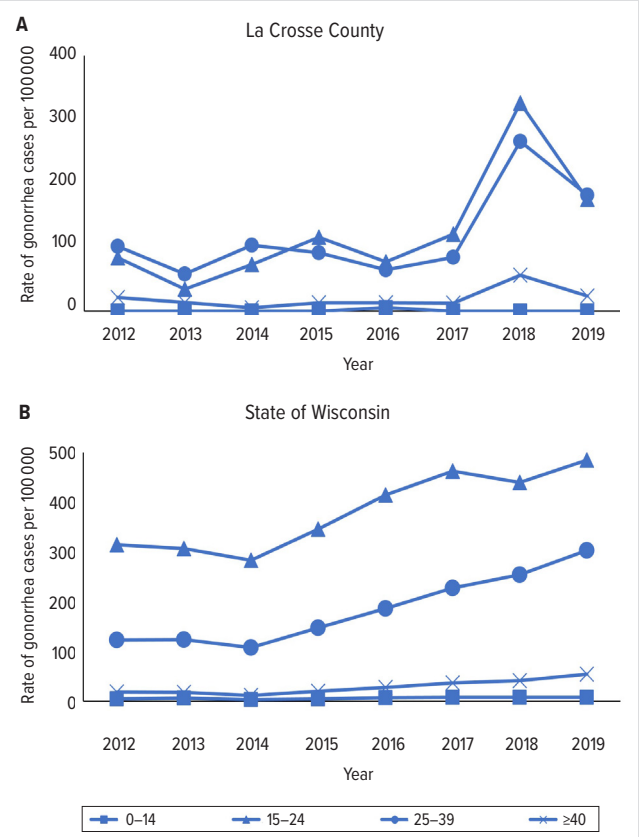
Using the incidence rate of gonorrhea infection per 100 000 at the county, state, and national levels, the total number of gonorrhea cases also rose over this time period (Table 2). To assess how age affects gonorrhea rates, the incidence rates of gonorrhea during 2012-2019 were collected only for La Crosse County

**Figure 3.** Annual Incidence Rates of Chlamydia Infections per 100 000 Population Identifying as White, Black, Native American/Alaskan Native, and Asian/Pacific Islander in (A) La Crosse County, (B) the State of Wisconsin, and (C) the United States, 2012–2019



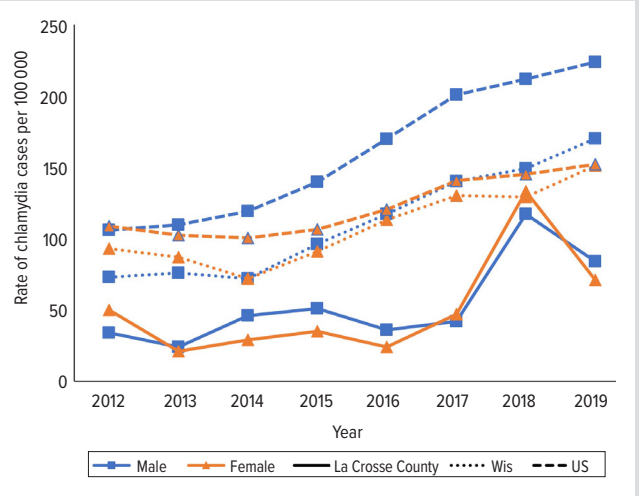

Data were collected from the Centers for Disease Control and Prevention Annual Morbidity and Mortality Reports and the Wisconsin Department of Health Services Sexually Transmitted Diseases Surveillance Reports.

**Figure 4.** Annual Incidence Rates of Gonorrhea Infections per 100 000 Population for Those Aged 0–14, 15–24, 25–39, and ≥40 Years Old in (A) La Crosse County and (B) the State of Wisconsin, 2012–2019




Data were collected from the Centers for Disease Control and Prevention Annual Morbidity and Mortality Reports and the Wisconsin Department of Health Services Sexually Transmitted Diseases Surveillance Reports.

**Figure 5.** Annual Incidence Rates of Gonorrhea Infections per 100 000 Population for Males and Females in La Crosse County, the State of Wisconsin, and the United States, 2012–2019




Data were collected from the Centers for Disease Control and Prevention Annual Morbidity and Mortality Reports and the Wisconsin Department of Health Services Sexually Transmitted Diseases Surveillance Reports.

and the State of Wisconsin. Gonorrhea infections rose significantly ($P < 0.001$) in La Crosse County (Figure 4A) and were even higher in the 15- to 24-year-old age group in the State of Wisconsin (Figure 4B). Within Wisconsin, the rate of gonorrhea infections in the 25- to 29-year-old age group was higher than rates in either the 0- to 14-year-old or ≥40-year-old age group. La Crosse County had gonorrhea rates that were similar for those aged 15 to 24 and 25 to 39 years old. Moreover, the F test showed there was a significant difference ($P < 0.001$) in the average higher incidence rate of gonorrhea infection between location and age group classification.

A Bonferroni analysis demonstrated that the average incidence of gonorrhea infection during 2012-2019 was not significantly different among the 0 to 14 age group ($P = 0.835$) and the ≥40 age group ($P = 0.689$) between La Crosse County and the State of Wisconsin. However, the gonorrhea rates among those 15 to 24 ($P < 0.001$) and 25 to 39 years old ($P = 0.006$) were significantly higher in the state versus the county.

A Bonferroni analysis demonstrated significantly lower gonorrhea incidence rates in those 0 to 14 years of age ($P < 0.001$) and ≥40 years of age ($P = 0.008$ to $P < 0.001$) compared to those 15 to 24 and 25 to 39 years old in La Crosse County and the State of Wisconsin. There was no significant difference between those aged 0 to 14 or ≥40 years old ($P = 1.000$) in average gonorrhea rates in the county or the state. However, the average incidence rate of gonorrhea infection among those 15 to 24 years of age was significantly higher ($P < 0.001$) than the rate among those 25 to 39 years old in the state, while there was no significant difference among those 15 to 24 or 25 to 39 years of age in the county.

### *Incidence by Sex*

Although sex played a role in chlamydia cases, it did not appear to affect gonorrhea infection rates. Overall, the gonorrhea incidence rate rose significantly at the county, state, and national levels for both sexes during 2012-2019 ($P < 0.001$, Figure 5). The US had the highest overall rate and La Crosse County had the lowest. However, there was no significant difference in the average gonorrhea incidence rate in females versus males ($P = 0.144$) or between location and sex ($P = 0.266$).

### *Incidence by Race*

People identifying as Black had the highest incidence rate of gonorrhea infection per 100 000 population compared to any other racial group at all levels (Figure 6). Within La Crosse County and the State of Wisconsin, the rate of infection in the Black and Native American/Alaskan Native populations versus other races was higher than the US.

An F test confirmed a significant difference ($P = 0.003$) in gonorrhea infection rates in La Crosse County, the State of Wisconsin, and the US when race was aligned with location. Significant differences ($P < 0.001$) were noted among the average incidence rate

of gonorrhea infections between the different racial groups as well as between location and racial classification. Using the Bonferroni post-hoc test, the average incidence of gonorrhea infection during 2012-2019 among those identifying as White ($P = 1.000$), Native American/Alaskan Native ($P = 0.231$ to 1.000) or Asian/Pacific islander ($P = 1.000$) was not significantly different when comparing all 3 levels. However, the Black population had significantly higher gonorrhea rates in the county and state ($P < 0.0001$) when compared to the rate in the US, but no significant difference was observed between the rates La Crosse County and the State of Wisconsin ($P = 0.362$).

Next, the 2-way ANOVA plus Bonferroni post-hoc test demonstrated that the average gonorrhea incidence rate during 2012-2019 was significantly higher in the Black population at the county, state, and national levels ($P < 0.0001$). There was no significant difference in the average gonorrhea incidence rate ($P = 0.076$ to 1.000) between those identifying as White, Native American/Alaskan Native, or Asian/Pacific Islander at the county, state, or national levels.

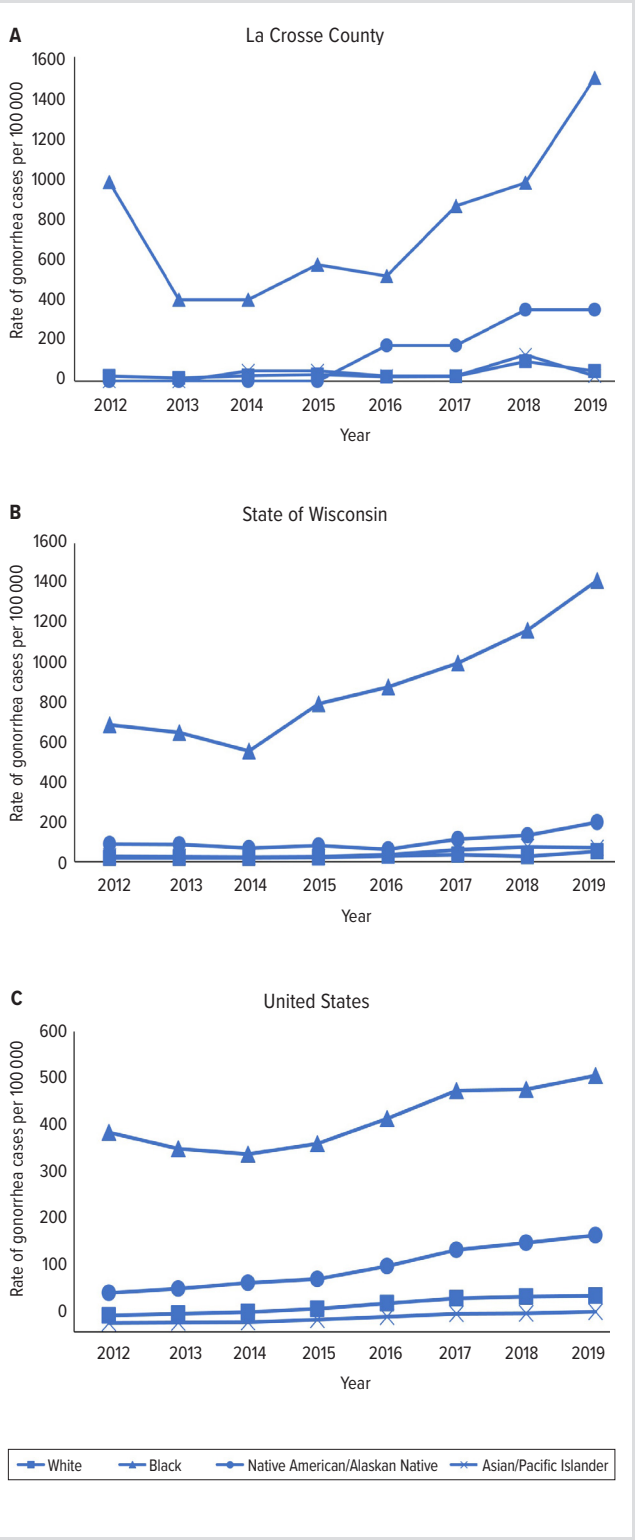
## DISCUSSION

Chlamydia and gonorrhea rates have risen steadily over the last 2 decades despite better detection methods and screening for STIs.[1-4] Our study found an increase in the annual rate of chlamydia cases from 2001 through 2020 in the US (783 242 to 1 335 916), the State of Wisconsin (16 284 to 22 277), and La Crosse County (266 to 598). Cases of gonorrhea also rose nationally (361 705 to 564 110), in Wisconsin (6011 to 8315), and in La Crosse County (55 to 163) during this time period.

Past studies have shown that over 50% of newly diagnosed STIs in the US are in those aged 15 to 24.[1,4] Further, both diseases may be rising in those 25 to 39 years of age.[12,13] The highest infection rates in La Crosse County and the State of Wisconsin during 2012-2019 were in those aged 15 to 24, matching previous studies.[1,4] Additionally, the rates of chlamydia and gonorrhea infection in those aged 25 to 39 were lower than the rates in the 15 to 24 age group, but were significantly higher in La Crosse County and the State of Wisconsin than other age groups. The increase in cases in the older age groups in Wisconsin is a concern, because the CDC does not recommend screening for asymptomatic chlamydia and gonorrhea infections in this group of patients.[14-16]

Besides the higher number of STIs in certain age groups, females had higher chlamydia and gonorrhea rates than males, a disparity this study reaffirms for chlamydia cases.[1] However, the average rates of gonorrhea infection did not differ significantly when comparing males to females at the county, state, or national levels. The disparity in infection rates could be due to the asymptomatic nature of chlamydia infections and less screening for men who have sex with women.[1,4,5]

**Figure 6.** Annual Incidence Rates of Gonorrhea Infections per 100 000 Population Identifying as White, Black, Native American/Alaskan Native, and Asian/Pacific Islander in (A) La Crosse County, (B) the State of Wisconsin, and (C) the United States, 2012–2019




Data were collected from the Centers for Disease Control and Prevention Annual Morbidity and Mortality Reports and the Wisconsin Department of Health Services Sexually Transmitted Diseases Surveillance Reports.

## CONCLUSIONS

We were able to show demographic differences in the incidence rates of both chlamydia and gonorrhea for the study period. Based on these findings, it is recommended that the 25- to 39-year-old group undergo more regular comprehensive screening for all sexually transmitted infections.

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