

# Impact of COVID-19 Pandemic on the Incidence of Sexually Transmitted Infections in Northern Finland in 2019 to 2022

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**The coronavirus SARS-CoV-2 (COVID-19) pandemic led to major restrictions in daily life and social contacts in Finland in March 2020. The effect of these restrictions on sexually transmitted infections (STIs) is unclear. The aim of this study was to analyse the incidence and positive rates of sexually transmitted infections in Northern Finland between 2020 and 2021 and compare these with the years prior to the pandemic. Numbers of positive *Chlamydia trachomatis*, HIV and hepatitis C samples were lower in 2020 to 2021 than in previous years, whereas more gonorrhoea and syphilis was found during pandemic than in previous years. The number of new cases of *C. trachomatis* reported each month decreased in the first months of the pandemic, but exceeded the prior pandemic-level in autumn 2020. When the mean positive sample rates were compared with the years 2015 to 2019, there was a significant decrease in positive *C. trachomatis* ( $p < 0.001$ ) and hepatitis C ( $p < 0.001$ ) sample rates in both 2020 and 2021. The positive rates for *Treponema pallidum* in 2020 did not differ significantly ( $p = 0.38$ ) from previous years. In conclusion, these results show that sexually transmitted infections occurred despite recommendations for social distancing during the COVID-19 pandemic. Thus, easy access to STI testing should always be available, even during exceptional circumstances.**

**Key words:** pandemic; COVID-19; sexually transmitted infection; gonorrhoea; chlamydia.

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Sexually transmitted infections (STIs) are one of the most common type of acute infections worldwide, causing a substantial burden for individuals, especially if untreated (1). Despite slight variation between years in the number of STIs in Finland, the number of all STI cases has been increasing (2). In Finland it is mandatory to report STIs, and in 2019 there were a total of 16,178 cases of *Chlamydia trachomatis*, 605 of *Neisseria gonorrhoea*, 246 of *Treponema pallidum*, and 150 of

## SIGNIFICANCE

Sexually transmitted infections are extremely common, especially in young people. Moreover, sexually transmitted infections can lead to severe complications if untreated. The reported effect of social restrictions during the COVID-19 pandemic on the number of sexually transmitted infections varies. This study examined the incidence and positive rates of sexually transmitted infections in Northern Finland in 2020 to 2021, during COVID-19 restrictions, and compared these with the years preceding the pandemic. Number of some, but not all, sexually transmitted infections decreased during the pandemic. There was a significant decrease, especially in positive *Chlamydia trachomatis* ( $p < 0.001$ ) and hepatitis C ( $p < 0.001$ ) sample rates, in both 2020 and 2021 compared with the years before the pandemic. Thus, surprisingly, social restrictions did not markedly reduce the overall number of sexually transmitted infections.

HIV nationwide (2). In recent years STI transmission has also been increasing in other European countries and in the USA (3–5).

At the beginning of 2020 coronavirus SARS-CoV-2 (COVID-19) emerged and rapidly developed into a worldwide pandemic. The first case of COVID-19 in Europe was diagnosed early in 2020. In Finland, the first infection was diagnosed in February 2020 (2). In an attempt to control the spread of the virus a nationwide lockdown was announced in Finland in mid-March 2020, with mass-scale restrictions imposed on physical and social interactions. Almost all schools were closed for 6 weeks, and most government-run public facilities, restaurants and hotels were closed for 2 months. In restaurants opening times and the numbers of customers were further restricted until October 2020 and restaurants were closed again for 3 weeks in March 2021. Social distancing in varying extent was recommend from March 2020 until May 2021 (6).

This study hypothesized that casual sexual encounters would have decreased during the period that recommendations for social distancing were in place due to the pandemic and, therefore, sexually transmitted infections (STIs) would decrease for this period. Previous studies have shown that pandemic restrictions had varying effects on the incidence of STIs in Europe (7, 8).

The aim of this study was to determine whether the restriction measures imposed to limit the spread of the SARS-CoV-2 had an impact on the incidence of STIs or positive rates of STI tests in Northern Finland (population  $n = 730,000$ ) between 2020 and 2021.

## MATERIALS AND METHODS

### Study population

All samples were taken during normal diagnostics in 2015 to 2022 and sent to Nordlab premises for identification of the following microbes: COVID-19 (SARS-CoV-2 from March 2020), *C. trachomatis*, *N. gonorrhoea*, *T. pallidum*, hepatitis C or HIV. Nordlab provides laboratory services for public primary, secondary and tertiary health for inhabitants of Northern Finland ( $n = 730,000$  of the total Finnish population of 5.5 million people).

Since study data was gathered from laboratory registry as numerical data only, no informed consent was required.

### Laboratory methods

Laboratory analyses were performed using routine methods. *C. trachomatis* and *N. gonorrhoeae* nucleic acids were identified using Abbott RealTime CT/NG Assay (Abbot Oy, Espoo, Finland) (9) or QIAgen NeumoDx CT/NG test strip (Qiagen, Helsinki, Finland) (10), respectively. HIV, *T. pallidum* and hepatitis C nucleic acids, as well as IgG antibodies to hepatitis C virus, were identified using Siemens Advia Centaur (Siemens, Espoo, Finland).

For SARS-CoV-2 nucleic acid identification, 1 of 7 individual analysis methods was used (11). The methods were verified into routine before use according to laboratory procedure. All results were recorded in the laboratory data system (Mylab, Tampere, Finland) from which summary reports were provided as part of the service to clinics.

### Statistical methods

Data are presented as proportions and means. A  $\chi^2$  test was used to analyse the difference in positive STI rates between years. In addition, 95% confidence intervals (95% CI) were calculated for proportions, constructed using Clopper and Pearson methods (12). A  $p$ -value  $< 0.05$  was considered statistically significant. Statistical analyses were conducted using the R software package

version 4.0.2 (The R Foundation, Vienna, Austria, <https://cran.rstudio.com>).

## RESULTS

The number of samples taken, positive samples and the rate of positive samples for SARS-CoV-2, *C. trachomatis*, *N. gonorrhoea*, *T. pallidum*, hepatitis C and HIV in the study region during 2015 to 2021 are shown in **Table I**. There was no significant difference in the overall number of STI samples taken between the years 2019 and 2020 despite the onset of the COVID-19 pandemic. The number of samples analysed for *T. pallidum* was greater in 2021 than in 2019 or 2020.

The annual total, numbers of positive *C. trachomatis*, HIV and hepatitis C samples were all lower during 2020 to 2021 than during 2015 to 2019, whereas the annual total numbers of positive gonorrhoea and syphilis samples were greater during 2020 to 2021 than during 2015 to 2019 (Table I). The monthly number of *C. trachomatis* infections was relatively constant in 2019, with a mean of 104 ( $\pm 18$ ) new cases/month. **Fig. 1** shows monthly correlation between positive (SARS-CoV-2) COVID-19 and *C. trachomatis* during 2019 to 2021 in study region: The number of new cases of *C. trachomatis* decreased from February 2020 until August 2020 (94, 35, 51, 23, 11, 30 and 50 cases/month, respectively). In September 2020, the number of new cases of *C. trachomatis* started to increase (113 cases/month), exceeding the previous level in October 2020 (137 cases).

Compared with the mean positive sample rate in the years 2015 to 2019, there was a significant decrease in positive *C. trachomatis* ( $p < 0.001$ ) and hepatitis C ( $p < 0.001$ ) sample rates in both 2020 and 2021. The positive rates for *T. pallidum* in 2020 did not differ significantly ( $p = 0.38$ ) from the mean of 2015 to 2019, but in 2021 there was a significant decrease compared with both the mean of 2015 to 2019 ( $p < 0.001$ ) and with 2020 ( $p < 0.05$ ). The decrease in positive rates of *N. gonorrhoea*

**Table I. Number of samples taken and positive findings for sexually transmitted infections, hepatitis C and SARS-CoV-2 (COVID-19) during 2015 to 2021 in Northern Finland**

Year	Positive samples/all samples taken					
	<i>Chlamydia trachomatis</i> $n$ (%; 95% CI)	<i>Neisseria gonorrhoeae</i> $n$ (%; 95% CI)	<i>Treponema pallidum</i> $n$ (%; 95% CI)	Hepatitis C $n$ (%; 95% CI)	HIV $n$ (%)	SARS-CoV-2 $n$ (%)
2015	1,677/25,389 (6.605; 6.304–6.919)	16/25,389 (0.063; 0.037–0.105)	36/2,746 (1.311; 0.933–1.831)	397/6,680 (5.943; 5.394–6.544)	16/8,046 (0.2)	
2016	1,873/25,629 (7.308; 6.994–7.635)	27/25,629 (0.105; 0.071–0.156)	28/3,613 (0.775; 0.525–1.134)	299/6,966 (4.292; 3.834–4.802)	18/9,116 (0.2)	
2017	1,626/25,238 (6.443; 6.144–6.754)	18/25,238 (0.071; 0.044–0.115)	46/10,442 (0.441; 0.326–0.593)	383/10,405 (3.681; 3.331–4.065)	23/15,794 (0.1)	
2018	1,360/20,286 (6.704; 6.366–7.059)	15/20,286 (0.074; 0.043–0.125)	31/9,921 (0.312; 0.216–0.449)	397/11,318 (3.508; 3.18–3.867)	8/14,694 (0.1)	
2019	1,247/27,054 (4.609; 4.364–4.868)	9/27,054 (0.033; 0.016–0.066)	1/4,631 (0.022; 0.001–0.14)	195/10,551 (1.848; 1.604–2.128)	2/7,435 (0)	
2020	930/26,972 (3.448; 3.235–3.674)	17/26,972 (0.063; 0.038–0.103)	17/4,682 (0.363; 0.219–0.594)	126/10,068 (1.251; 1.048–1.493)	0/6,821 (0)	1,519/261,454 (0.6)
2021	897/22,359 (4.012; 3.76–4.279)	18/22,359 (0.081; 0.049–0.13)	7/5,436 (0.129; 0.056–0.278)	149/9,875 (1.509; 1.282–1.774)	1/6,979 (0)	8,956/325,227 (2.8)

95% CI: 95% confidence interval.

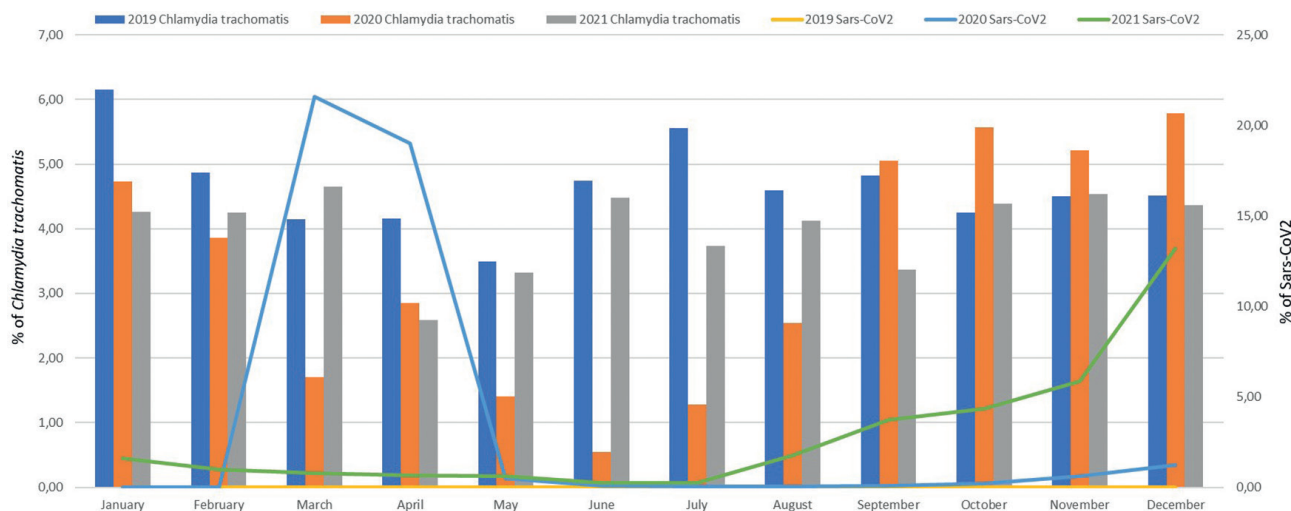


Fig. 1. Monthly positive rates for *Chlamydia trachomatis* and SARS-CoV-2 (COVID-19) during the years 2019 to 2021.

*hoec* samples between the mean of years 2015 to 2019 and 2020 or 2021 did not reach statistical significance. Since there were only a few cases of HIV during study period in study region, HIV was omitted from the statistical analyses (Table II).

## DISCUSSION

The main finding of this study is that the COVID-19 pandemic with social restrictions had a variable effect on transmission of STIs in Northern Finland. A reduction in chlamydia diagnoses was observed from the start of the national lockdown in March 2020. In addition, positive rates of chlamydia decreased significantly compared with previous years (2015–2019). Interestingly, for syphilis, the positive rates decreased only in 2021, while no such reduction was seen for gonorrhoea.

The incidence of STIs, including *C. trachomatis*, *N. gonorrhoea* and *T. pallidum*, have been increasing in Finland in recent years (2). It is not clear whether the increase is due to a real epidemiological increase in infections or an increased number of tests performed. In Finland, free, rapid, urine-based home samples for *C. trachomatis* and *N. gonorrhoea* reduce the donor effort in diagnostics for these infections (13), which probably increases the number of tests performed. However, the yearly numbers of STIs in Northern Finland have been relatively constant. The effect of COVID-19 restrictions

on STIs was first observed as a slightly decreased incidence of *C. trachomatis* in Northern Finland in spring 2020. However, in summer 2020, the rates started to increase again, reaching a similar level as before the COVID-19 pandemic by September 2020. This corresponds to the results of a study covering all of Finland, as well as findings from the USA (14, 15). However, in these studies only the incidence was analysed, and the number of samples analysed was not taken into account, although the testing possibilities were reduced during the pandemic (16). Taking this into account the current study found that, during the pandemic in 2020 to 2021, the yearly positive rates for *C. trachomatis* infection in the study region were 3.4% and 4.0%, respectively, which is significantly lower than the mean of years 2015 to 2019. Nevertheless, there is some seasonal variation in incidence of chlamydia in Finland (2). Since the reduction in incidence of chlamydia during the pandemic in spring–summer 2020 was marked compared with 2019 and the second year of the pandemic, we consider this to be related to the pandemic rather than just seasonal variation.

It is noteworthy that there were no significant differences in positive rates of *N. gonorrhoeae* during the pandemic years compared with 2015 to 2019. This may reflect the fact that gonorrhoea infections are more often symptomatic compared with chlamydia, thus leading individuals to seek medical help more actively. This was

Table II. Mean number of samples and positive rates in 2015 to 2019, and yearly numbers and positive rates in years 2020 and 2021 by pathogen

	Positive samples/samples taken (proportion of positive samples)		p-value (2015 to 2019 vs 2020)	Positive samples/samples taken (proportion of positive samples)		p-value (2015 to 2019 vs 2021)	p-value (2020 vs 2021)
	2015–2019	2020		2021			
<i>Chlamydia trachomatis</i>	7,783/123,596 (6.297)	930/26,972 (3.448)	<0.001	897/22,359 (4.012)	<0.001	<0.001	
<i>Neisseria gonorrhoeae</i>	85/123,596 (0.069)	17/26,972 (0.063)	0.742	18/22,359 (0.081)	0.543	0.468	
<i>Treponema pallidum</i>	142/31,353(0.453)	17/4,682 (0.363)	0.387	7/5,436 (0.129)	<0.001	0.015	
Hepatitis C	1,671/45,920 (3.639)	126/10,068(1.251)	<0.001	149/9,875 (1.509)	<0.001	0.119	

also seen in other European studies comparing patient characteristics before and during the pandemic (7, 8, 17). In comparison, positive rates for *T. pallidum* in 2020 were similar to previous years, but decreased significantly in 2021. Interestingly, a US study also found decreased incidence of syphilis, but not of gonorrhoea, during the first 30 weeks of the pandemic (14).

Many factors may have had an impact on the incidence of STIs during the COVID-19 pandemic. Many people stayed at home in social isolation. In Finland, all schools were closed for 6 weeks in March to April 2020. Adolescents in upper-level schools studied remotely until the end of spring semester 2020 and partially remotely during the 2020 to 2021 school year. At university level, studies continued mostly remotely until the end of 2021 or even mid-spring 2022. Remote working and social distancing were also strongly recommended. Places to meet, such as gyms, cinemas and libraries, were closed and many social activities were cancelled (6). *C. trachomatis* infections are often diagnosed in young adults (2), and this age group may have been less likely to follow recommendations for social distancing or may have ignored them more easily, which could partially explain the current findings. However, the current study was unable to analyse the incidences in different age groups.

It is noteworthy that, during the COVID-19 pandemic, healthcare resources in many countries were targeted at emergency patients (16), with less focus on other diseases, including STIs. In the current study, there were some microbe-specific reductions in the number of diagnostic STI samples taken during COVID-19 pandemic. Thus, the decrease in incidence of STIs may reflect a true decrease in infections, or, more likely, the fact that not all individuals could be tested.

In general, social distancing has an effect on infection rates (18); an individual without person-to-person contacts has a lower risk of infection. Despite restrictions due to the pandemic, this study did not find a remarkable decrease in the amount of all STIs in Northern Finland during 2020 and 2021, thus the study hypothesis is not supported. The current study observed a decrease in cases of chlamydia at the start of the pandemic, but the number of diagnoses started to increase again by the end of the first pandemic year. Interestingly, the number of cases diagnosed with gonorrhoea increased during the pandemic in 2020 to 2021. Corresponding results for chlamydia and gonorrhoea during the pandemic have also been reported in Hungary (8). This may be because, during exceptional circumstances, especially, people need contact with other people (19). However, it is not yet possible to draw conclusions regarding the long-term impact of the entire COVID-19 pandemic on STIs. Nevertheless, it is important to remember that STIs can lead to severe complications if untreated (20), and, in addition, the risk of transmission increases if infections remain unnoticed.

The current study shows that the incidence of STIs can increase despite social restrictions. Thus, possibilities for easy testing for STIs within healthcare centres or by self-collection (13) should always be provided regardless of exceptional circumstances.

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