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# Potential impact of the COVID-19 pandemic on the national and regional incidence, epidemiology and diagnostic testing of chlamydia and gonorrhoea in Sweden, 2020

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The COVID-19 pandemic has challenged the societies and health care systems globally, and resulted in many social and physical distancing restrictions to limit the spread of SARS-CoV-2. These restrictions have also likely affected the frequency of intimate contacts and the spread of sexually transmitted infections (STIs). Compared to most other countries, Sweden especially in Spring-Autumn 2020 pursued mainly milder voluntary, that is, not mandatory enforced by laws, recommended restrictions and the impacts of these on society and spread of STIs remain largely unknown. We describe the potential impact of the COVID-19 pandemic on the national and regional incidence, epidemiology and diagnostic testing of chlamydia and gonorrhoea in Sweden in 2020. Compared to 2019, we found a significant decrease in incidence of chlamydia (−4.5%) and gonorrhoea (−17.5%), and in diagnostic testing (−10.5% for chlamydia, −9.4% for gonorrhoea) in 2020. However, the decrease in chlamydia incidence, which has mainly been decreasing in the last 10 years, was not significant when compared with the average incidence in 2017–2019. The largest decrease in national incidence of both infections was observed among young and heterosexual patients, however, some Swedish regions showed an increased incidence, particularly of chlamydia. Increased "internet-based self-sampling" testing approach partly compensated for a decreased attendance at STI clinics. Studies, including sexual behaviour, prevention, reasons for attending STI health care, STIs in different anatomical sites and management of STIs, are required to elucidate the impact of COVID-19-associated social and physical distancing restrictions on sexual activity and the incidence and epidemiology of chlamydia and gonorrhoea in Sweden.

Key words: COVID-19; *Chlamydia trachomatis*; *Neisseria gonorrhoeae*; sexually transmitted infections; social and physical distancing; Sweden.

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The Coronavirus disease 2019 (COVID-19) pandemic, caused by the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), is one of the largest global public health crisis of our time [1–3] and had by the end of August 2021 resulted in approximately 4.5 million global death cases [3]. The COVID-19 pandemic forced countries to introduce social and physical distancing restrictions, and the health care services to adjust and redirect resources (human and funds) [2, 4]. In Sweden, the first COVID-19 case was confirmed on January 31, 2020, and when larger domestic spread of SARS-

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CoV-2 was subsequently detected in March 2020 Sweden responded with a more lenient strategy compared to most other countries, that is, implementing mainly voluntary recommended restrictions. Initial national recommendations in March 2020 included staying home when having symptoms compatible with COVID-19, working from home when feasible and when employers allowed, for individuals >70 years of age to limit close interpersonal contacts and avoid crowded places such as public transportation and shops (from 16 March 2020), and to avoid unnecessary trips within the country (from 19 March 2020). By 1 April 2020, a regulation complementing the Communicable Diseases Act of Sweden (www.riksdagen.se/sv/dokument-lagar/svensk-forfattningssamling/smittskyddslag-2004168_sfs-2004-168) was decided, which comprised recommendations directed to the society but without any lockdown or mandatory quarantine procedures, for example, for COVID-19-infected households or geographical regions, and bars, restaurants and shops stayed open [5–7]. Schools for children >16 years of age used remote teaching between 17 March to June, 2020, while younger children continued to attend school and kindergartens. Public gatherings were restricted to ≤50 people from 27 March 2020, and to ≤8 people from 20 November 2020 [7]. Physical distancing (from an 'arm length distance' to 2 m was advised in different places) was recommended in public places, and was mandatory in bars, restaurants, at events and when visiting elderly care homes [5, 6]. Stricter regulations on bars and restaurants were implemented on 20 November 2020, by banning sales of alcohol after 10:00 p.m. and closing by 10:30 p.m., which was later further restricted to 8:00 p.m. and 8:30 p.m. respectively (24 December 2020). From 7 January 2021, there was a national recommendation to use face masks on all public transportation on weekdays 7:00–9:00 a.m. and 4:00–6:00 p.m. (rush hours), that is, if born in 2004 or older [6, 8].

The social and physical distancing restrictions implemented during the COVID-19 pandemic have also potentially affected the frequency of sexual contacts, especially with new partners, and the spread of sexually transmitted infections (STIs). However, internationally there has also been a concern that STI patients have not been diagnosed [4]. For example, individuals with STI-associated symptoms during the pandemic may have avoided attending health care centres because of being afraid of (i) contracting COVID-19 during a visit to a hospital or other sexual health care centres or (ii) becoming judged for having new or short-time sexual contacts during a time when meeting people outside one's own household is not recommended [4]. Furthermore, the COVID-19 pandemic has substantially challenged the global health care systems, where human and economic resources were rapidly shifted, including primary health care, hospital health care and public and private laboratories, and people with symptoms of STIs or worries of being infected may also have had less access to STI health care and diagnostic testing. Finally, STIs such as chlamydia and gonorrhoea can frequently be asymptomatic, especially in women and extragenital infections [9], and many of these asymptomatic cases may not have accessed STI health care or testing.

No scientific studies regarding the impact of the COVID-19 pandemic on the bacterial STIs in Sweden, with its unique and more lenient COVID-19 strategy, have been published. Across Sweden, nucleic acid amplification tests (NAATs) are used for diagnosis of chlamydia and gonorrhoea, and these STIs are mandatorily notifiable. Individuals can be tested free-of-charge for chlamydia and gonorrhoea by visiting an STI clinic at a hospital, youth centre or other health care centre, or by ordering a self-sampling kit through an internet health care portal, and then the sample is posted to a local diagnostic laboratory for NAAT analysis [10].

Our aim was to describe the potential impact of the COVID-19 pandemic on the national and regional incidence, epidemiology and diagnostic testing of chlamydia and gonorrhoea in Sweden in 2020.

## MATERIALS AND METHODS

### Study population

Chlamydia and gonorrhoea cases mandatorily reported, according to the Communicable Diseases Act of Sweden (www.riksdagen.se/sv/dokument-lagar/svensk-forfattningssamling/smittskyddslag-2004168_sfs-2004-168), to the Public Health Agency of Sweden [11] were examined. Briefly, cases are reported by the Communicable Disease Officer in each Swedish County, that is, after collection of the laboratory and clinician reports of each case. In general, separate cases (infection episodes) of the same patient are considered if it is ≥3 weeks between two laboratory reports and patient had a negative test-of-cure for the initial infection episode. The main time period for the analyses was from January 2019 to December 2020, however, the annual reported incidence rates (cases per 100,000 inhabitants) of chlamydia and gonorrhoea from 2010 to 2020, as well as incidences by age and gender from 2010 to 2020 [11] were additionally investigated.

### Diagnostic NAAT testing for chlamydia and gonorrhoea in 2019 and 2020

The numbers of NAAT tests (each reported case could have several NAAT tests) performed for diagnosis of

 

chlamydia and gonorrhoea aggregated by year (2019 or 2020), month and sex (man, woman, not reported) were collected through a request form submitted to all the main STI diagnostic laboratories in the 21 health care regions of Sweden.

### Statistics

Statistical analysis was performed using Z-ratio in VassarStats (http://vassarstats.net/) to determine if the difference between data collected in 2019 versus 2020 was significant. Statistical significance was set at $p < 0.05$.

### Ethics

All data on chlamydia and gonorrhoea cases were aggregated data (year, age groups, sex and region) available from the Public Health Agency of Sweden [11]. Furthermore, aggregated data (year, month, sex and region) on diagnostic testing performed in routine practice (standard care) were examined. No patient identification data were available. Accordingly, no ethical approval was required.

## RESULTS

### Incidence and epidemiology of chlamydia and gonorrhoea

The reported national incidence rates of chlamydia in Sweden slowly decreased from 2010 to 2020, with the exception of minor increases in 2015 and 2019 (Fig. 1A).

In 2019 and 2020, the national chlamydia incidence was 336.4 cases per 100,000 inhabitants (n = 34742 cases) and 321.3 cases per 100,000 inhabitants (n = 33351), respectively, which represented a significant decrease of 4.5% ($p < 0.05$). Accordingly, the reported incidence of chlamydia in 2020 decreased to nearly the incidence observed in 2018 (312.8 cases per 100,000 inhabitants), when the lowest incidence during the recent decade was recorded. However, because the chlamydia incidence has been decreasing during the recent decade, but for a minor increase in 2019, the chlamydia incidence in 2020 was also compared with the average incidence in 2017–2019, and in this analysis the decrease in chlamydia incidence in 2020 was not significant ($p = 0.06$).

The national incidence of gonorrhoea steadily increased from 2010 to 2019, but then decreased significantly in 2020 ($p < 0.05$) when it dropped approximately to the incidence reported in 2017 (Fig. 1B). The national reported gonorrhoea incidence was 31.4 cases per 100,000 inhabitants (n = 3245 cases) and 25.9 cases per 100,000 inhabitants (n = 2692) in 2019 and 2020, respectively, which corresponded to a 17.5% decrease.

Figure 2 summarises the incidence of chlamydia and gonorrhoea by sex and age.

Women accounted for approximately 56% of the chlamydia cases in both 2019 and 2020 (Fig. 2A), while they only accounted for approximately 27% and 23% of the gonorrhoea cases in 2019 and 2020 respectively (Fig. 2B). In general, patients aged 20–24 years had the highest incidences of both chlamydia and gonorrhoea. Notably, men aged 25–34 years had a slightly higher incidence of gonorrhoea than 20–24-year-old men in 2020, which was not observed in any of the previous years. Women aged 15–19 years also had high incidences, particularly of chlamydia. Most of the decreased incidence of gonorrhoea in 2020 compared to 2019 was caused by the significant decrease among women and men in the age groups 20–24 years and 25–34 years ($p < 0.05$) (Fig. 2B).

In Table 1, the proportions of national cases of chlamydia and gonorrhoea in 2019 and 2020 by sex, sexual orientation and country of infection (Sweden or abroad) are summarised.

For chlamydia, the proportions were relatively stable, except that the proportion of cases infected abroad significantly decreased ($p < 0.05$). However, for gonorrhoea, the proportions of cases among men who have sex with women (MSW) and women significantly decreased ($p < 0.05$), while the proportion among men who have sex with men (MSM) significantly increased ($p < 0.05$) (Table 1). Furthermore, the proportion of cases infected in Sweden significantly increased ($p < 0.05$), while the proportion of those infected abroad significantly decreased ($p < 0.05$) (Table 1). Notably, in 2019 the ratio of reported symptomatic and asymptomatic male gonorrhoea cases was 1.3, while in 2020 this ratio was only 0.93. Accordingly, the proportion of reported symptomatic male gonorrhoea cases significantly decreased from 2019 to 2020 ($p < 0.05$). In 2019, this symptomatic/asymptomatic ratio ranged from 1 to 1.8 during the 12 months, while in April and May 2020 (during the first wave of the COVID-19 pandemic in Sweden) it was only 0.79 and 0.81, respectively, and in September–November 2020 (during the second wave of the COVID-19 pandemic in Sweden) it ranged from 0.72 to 0.76. For the less frequently symptomatic gonorrhoea cases in women and chlamydia cases in men or women, there were no significant differences in the proportion of symptomatic cases in 2020 compared to 2019 (data not shown).

The number of gonorrhoea cases by sex and sexual orientation showed that the number of cases among MSM slightly increased, while the number of cases significantly decreased among MSW and women ($p < 0.05$) (Fig. 3).

 

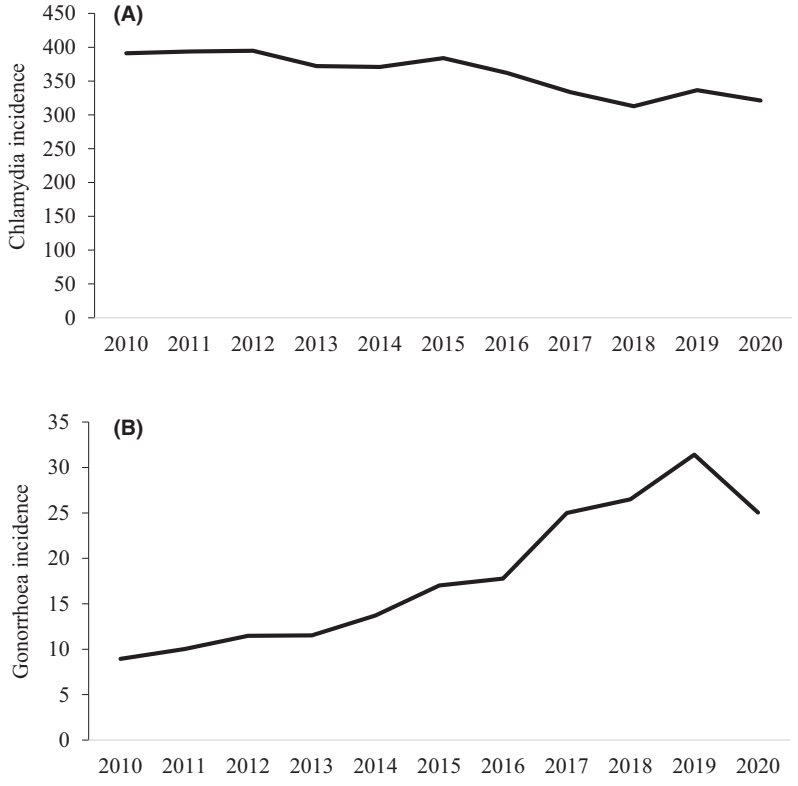


**Fig. 1.** National reported incidence (cases per 100,000 inhabitants) of chlamydia (A) and gonorrhoea (B) in Sweden in 2010–2020 [11].

The incidence of chlamydia not only decreased, from −0.4% (Jönköping) to −31.6% (Norrbotten), in 12 of the 21 health care regions in Sweden, but also increased in nine regions, from +0.8 (Kalmar) to +47.4% (Blekinge). The incidence of gonorrhoea decreased in all the 21 regions, that is, from −3.3% (Västmanland) to −79.3% (Västerbotten) (Table 2).

### Diagnostic NAAT testing for chlamydia and gonorrhoea in 2019 and 2020

In total, 2,189,184 NAAT analyses for diagnosis of chlamydia and gonorrhoea in 2019 and 2020 were reported (Table 3).

These NAAT testing data were reported by 19 (90.5%) of the 21 health care regions in Sweden, unfortunately no data were reported from Jämtland and Södermanland. Kronoberg and Blekinge regions collaborate in their performance of NAATs for diagnosis of chlamydia and gonorrhoea and their testing data are therefore merged (Table 3).

In these 19 Swedish health care regions, 1,151,857 NAAT tests for diagnosis of chlamydia and gonorrhoea were performed in 2019 and 1,037,327 in 2020, which corresponds to a decrease by 9.9%. The number of NAAT tests performed for diagnosis of chlamydia decreased in all reporting regions, from −3.3% (Västernorrland) to −24.1% (Norrbotten). For diagnosis of gonorrhoea, the number of performed NAAT tests decreased in all reporting regions, from −3.3% (Västernorrland) to −25.3% (Norrbotten), except in Västerbotten and Gotland where an increased testing by +21.1% and +1.3%, respectively, was observed. The average change among all regions was a significant ($p < 0.05$) decrease of 10.5% and 9.4% in the number of NAAT tests performed for diagnosis of chlamydia and gonorrhoea respectively (Table 3). Nationally, the NAAT testing for chlamydia and gonorrhoea decreased by 17.9% when comparing March–May 2020 ("first wave of COVID-19") to the same months in 2019 and decreased by 12.2% in June–August 2020 compared to June–August in 2019. None of the Swedish health care regions reported a >50% decrease in neither March–May 2020 nor June–August 2020, compared to the same time periods in 2019. Notably, the number of NAAT tests performed for women in 2020 decreased by 16.6% and 13.1% for chlamydia and gonorrhoea, respectively, while the decrease for men was only 7.6% and 8.7% respectively.

 

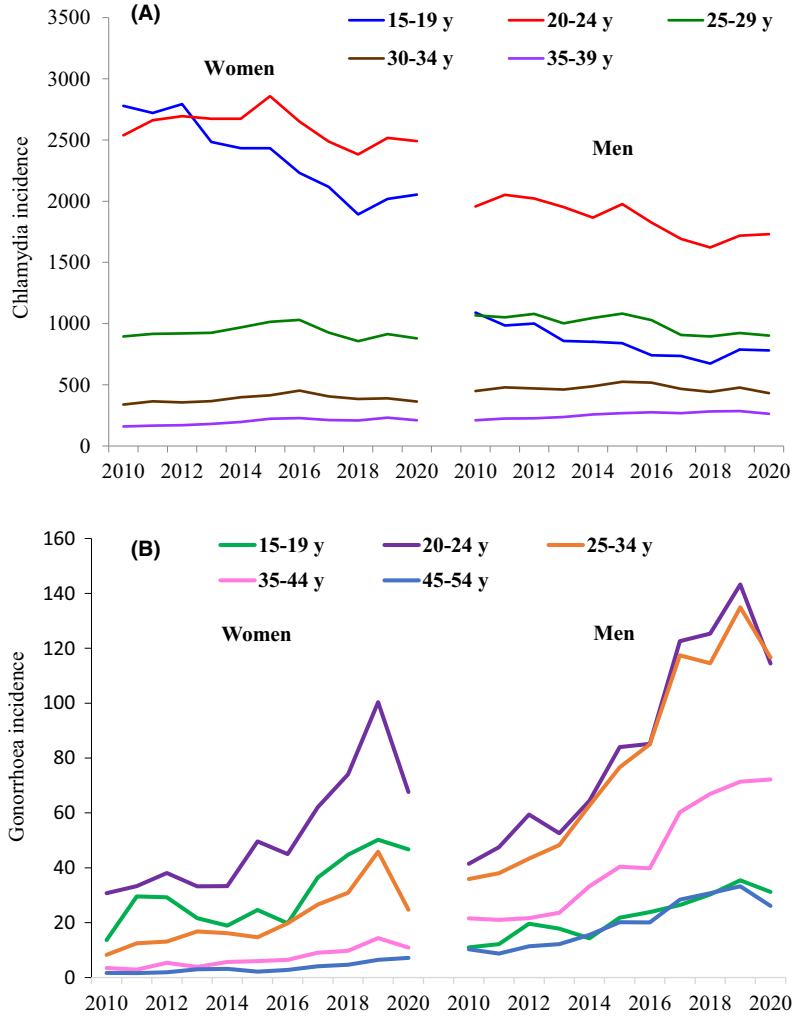


**Fig. 2.** Reported incidence (cases per 100,000 inhabitants) of chlamydia (A) and gonorrhoea (B) in Sweden in 2010–2020, by sex and age (years, y) [11]. The occasional cases <15 years of age (for both chlamydia and gonorrhoea), >54 years (for gonorrhoea) and >39 years (for chlamydia) have been excluded.

**Table 1.** Proportion (%) of national reported cases of chlamydia and gonorrhoea by sex, sexual orientation and country of infection (Sweden or abroad), 2019 and 2020 [11]

| | Chlamydia | | | Gonorrhoea | | |
|---|---|---|---|---|---|---|
| | 2019 | 2020 | Difference | 2019 | 2020 | Difference |
| MSW | 36.9 | 36.8 | −0.1 | 24.4 | 19.1 | −5.3 |
| MSM | 5.2 | 5.3 | +0.1 | 46.5 | 55.3 | +8.8 |
| Women | 55.8 | 55.6 | −0.2 | 27.4 | 23.1 | −4.3 |
| Unknown/Other | 2.1 | 2.3 | +0.2 | 1.6 | 2.5 | +0.9 |
| Sweden | 89.0 | 92.7 | +3.7 | 74.3 | 83.8 | +9.5 |
| Abroad | 8.5 | 4.7 | −3.8 | 23.9 | 12.9 | −11.1 |

MSM, men who have sex with men; MSW, men who have sex with women.

## DISCUSSION

In Sweden, both the incidence of and the number of diagnostic NAAT tests for chlamydia and gonorrhoea significantly decreased during 2020 compared to 2019. The chlamydia incidence was, however, not significantly lower in 2020 compared to the average incidence in 2017–2019 ($p = 0.06$).

 

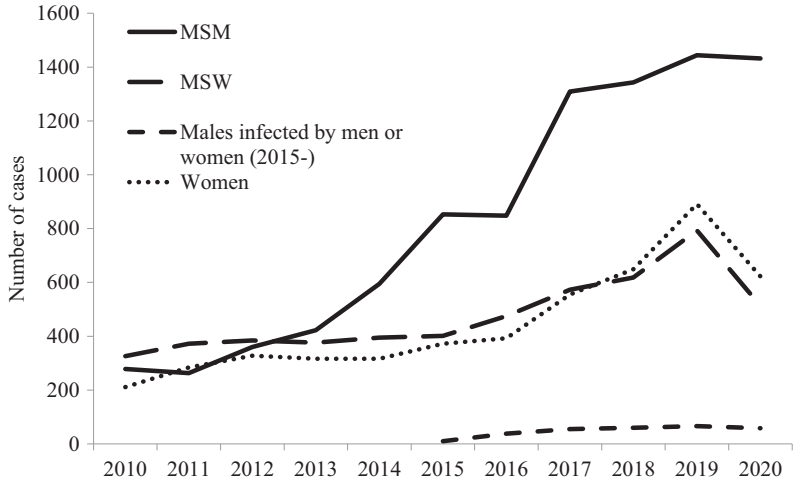


**Fig. 3.** Reported number of gonorrhoea cases in Sweden in 2010–2020, by sex and sexual orientation [11]. MSM, men who have sex with men, MSW, men who have sex with women.

**Table 2.** Reported incidence (cases per 100,000 inhabitants) of chlamydia and gonorrhoea by region, 2019 and 2020 [11]

| Region | Chlamydia | | | Gonorrhoea | | |
|---|---|---|---|---|---|---|
| | 2019 | 2020 | Difference | 2019 | 2020 | Difference |
| Blekinge | 154.8 | 228.2 | +47.4 | 5.6 | 2.5 | −55.4 |
| Dalarna | 328.5 | 295.8 | −10.0 | 8.3 | 6.6 | −20.5 |
| Gotland | 388.7 | 301.0 | −22.6 | 15.1 | 10.0 | −33.8 |
| Gävleborg | 298.9 | 335.0 | +12.1 | 15.0 | 9.0 | −40.0 |
| Halland | 314.2 | 307.6 | −2.1 | 13.8 | 9.2 | −33.3 |
| Jämtland | 293.6 | 393.4 | +34.0 | 14.5 | 3.0 | −79.3 |
| Jönköping | 262.1 | 261.1 | −0.4 | 10.7 | 7.1 | −33.6 |
| Kalmar | 248.5 | 250.4 | +0.8 | 5.7 | 4.1 | −28.1 |
| Kronoberg | 270.0 | 286.8 | +6.2 | 7.4 | 6.4 | −13.5 |
| Norrbotten | 364.7 | 249.6 | −31.6 | 12.0 | 4.4 | −63.3 |
| Skåne | 326.2 | 315.0 | −3.4 | 28.1 | 22.9 | −18.5 |
| Stockholm | 417.7 | 376.5 | −9.9 | 75.6 | 69.4 | −8.2 |
| Södermanland | 265.2 | 284.2 | +7.2 | 24.5 | 9.0 | −63.3 |
| Uppsala | 353.4 | 333.9 | −5.5 | 27.1 | 19.6 | −27.7 |
| Värmland | 252.1 | 289.9 | +15.0 | 11.0 | 5.3 | −51.8 |
| Västerbotten | 291.8 | 282.6 | −3.2 | 14.0 | 2.9 | −79.3 |
| Västernorrland | 300.8 | 334.9 | +11.3 | 13.5 | 3.3 | −75.6 |
| Västmanland | 358.2 | 332.0 | −7.3 | 12.3 | 11.9 | −3.3 |
| Västra Götaland | 334.3 | 308.3 | −7.8 | 23.5 | 17.9 | −23.8 |
| Örebro | 331.0 | 383.1 | +15.7 | 10.2 | 8.5 | −16.7 |
| Östergötland | 306.6 | 275.9 | −10.0 | 13.3 | 12.0 | −9.8 |
| Sweden, total | 336.4 | 321.3 | −4.5 | 31.4 | 25.9 | −17.5 |

Furthermore, the incidence of chlamydia increased in 9 (42.9%) of the 21 Swedish health care regions. The relatively extensive decrease in gonorrhoea incidence compared to chlamydia incidence can be due to several reasons. First, international travel restrictions will affect the incidence of gonorrhoea more due to the relatively large proportion of gonorrhoea cases infected abroad during ordinary years. Second, many of the reported gonorrhoea cases in ordinary years are among MSM with asymptomatic infections in the pharynx and anorectum [11] and might not have been diagnosed and treated because they did not approach healthcare for testing and are not included in any national screening programme. However, this is likely not a significant contributor because the proportion of asymptomatic male gonorrhoea cases increased in 2020. Third, these STIs are not spreading frequently in the identical core groups, which have different associations with sexual orientation, some age groups and frequency of infection abroad versus in Sweden (Table 1, Fig. 2). The number of diagnostic NAAT tests for both chlamydia and gonorrhoea significantly decreased in 2020, except in Gotland and

 

**Table 3.** Number of nucleic acid amplification tests (NAATs) performed for diagnosis of chlamydia and gonorrhoea in 2019 and 2020, by region

| Region | NAATs, Chlamydia 2019 | NAATs, Chlamydia 2020 | Difference | NAATs, Gonorrhoea 2019 | NAATs, Gonorrhoea 2020 | Difference |
|---|---|---|---|---|---|---|
| Blekinge and Kronoberg | 14,818 | 14,188 | −4.3 | 14,818 | 14,188 | −4.3 |
| Dalarna | 16,740 | 15,130 | −9.6 | 16,740 | 15,130 | −9.6 |
| Gotland | 3186 | 3079 | −3.4 | 2240 | 2269 | +1.3 |
| Gävleborg | 16,739 | 15,361 | −8.2 | 16,760 | 15,391 | −8.2 |
| Halland | 17,897 | 15,528 | −13.2 | 17,897 | 15,528 | −13.2 |
| Jämtland[a] | | | | | | |
| Jönköping | 17,995 | 16,154 | −10.2 | 17,989 | 16,142 | −10.3 |
| Kalmar | 12,188 | 11,346 | −6.9 | 12,188 | 11,356 | −6.8 |
| Norrbotten | 11,785 | 8947 | −24.1 | 12,203 | 9119 | −25.3 |
| Skåne | 114,798 | 102,050 | −11.1 | 114,798 | 102,050 | −11.1 |
| Stockholm | 145,114 | 122,909 | −15.3 | 87,505 | 73,819 | −15.6 |
| Södermanland[a] | | | | | | |
| Uppsala | 25,131 | 22,104 | −12.0 | 25,134 | 22,107 | −12.0 |
| Värmland | 19,601 | 16,975 | −13.4 | 19,600 | 16,974 | −13.4 |
| Västerbotten | 16,119 | 14,660 | −9.1 | 12,117 | 14,670 | +21.1 |
| Västernorrland | 11,837 | 11,441 | −3.3 | 11,837 | 11,441 | −3.3 |
| Västmanland | 14,342 | 13,537 | −5.6 | 14,342 | 13,537 | −5.6 |
| Västra Götaland | 99,949 | 95,938 | −4.0 | 99,861 | 95,938 | −3.9 |
| Örebro | 19,688 | 17,576 | −10.7 | 19,688 | 17,576 | −10.7 |
| Östergötland | 29,135 | 26,617 | −8.6 | 29,078 | 26,552 | −8.7 |
| Sweden, total | 607,062 | 543,540 | −10.5 | 544,795 | 493,787 | −9.4 |

[a]Data not available.

Västerbotten regions where gonorrhoea NAAT testing increased. In Västerbotten region, 'internet-based self-sampling' testing approach for gonorrhoea was not available before 2020, which explains their 21.1% increase in NAAT testing for gonorrhoea. Taking into account the decreased international travelling and patients infected abroad, no obvious association between the decreased incidence and number of NAAT tests performed for chlamydia and gonorrhoea was observed from January to December 2020. Furthermore, the NAAT testing for chlamydia and gonorrhoea had not decreased as much as previously reported from many other WHO European countries [12]. This may partly be explained by the less severe social and physical distancing restrictions that have not stopped individuals from attending health care for NAAT testing but also the well-implemented system for "internet-based self-sampling" testing of chlamydia and gonorrhoea in Sweden. Such tests have been available for several years and a self-sampling kit can be ordered online through the internet health care portal 1177 Vårdguiden, www.1177.se, and specimens are subsequently mailed to a local diagnostic laboratory for NAAT analysis. This 'internet-based self-sampling' testing approach increased in Sweden in 2020 [13], for example, with 20.3% from 2019 to 2020 in Region Örebro (data not shown), which partly compensated for the decreased attendance at STI clinics [13]. However, the proportion of reported symptomatic male gonorrhoea cases significantly decreased in 2020, which indicates that many symptomatic men did not attend STI clinics for examination, testing and follow-up. Hopefully, these men were diagnosed by the 'internet-based self-sampling' testing approach and were subsequently successfully treated. This testing approach would beneficially be further promoted for both sexes and all ages in Sweden and internationally. In general, the attendance at health care settings decreased while the use of health care services and remote appointments provided through internet and telephone increased in Sweden during 2020 [13].

An early report [12] investigated health care providers in 34 WHO European countries regarding the impact of the first COVID-19 pandemic wave on testing for bacterial STIs (chlamydia, gonorrhoea and syphilis), HIV and viral hepatitis. Of respondents, 95% (92/98) reported that their number of tested people during March–May 2020 was lower, and 64% reported a >50% decline in diagnostic testing volume, compared to March–May 2019. In June–August 2020 compared to June–August 2019, a decline occurred in 58% of the test sites and 20% of them reported a >50% decline [12]. This could be explained by less strict restrictions in most countries during the summer of 2020. As mentioned above, the NAAT testing for chlamydia and gonorrhoea in Sweden decreased by only 17.9% in March–May 2020 and by 12.2% in June–August 2020 compared to the same month in

 

2019, and none of the Swedish health care regions reported a >50% decrease in these time periods in 2020 compared to 2019.

It remains unclear if the decreased NAAT testing for chlamydia and gonorrhoea is associated with the decreased incidences of these infections in Sweden in 2020. This is especially because it is unknown how much the voluntary recommended social and physical distancing restrictions have impacted the sexual behaviour and the sexual activity. A decreased ordering of condoms free-of-charge in Stockholm (the largest health care region) may indicate a reduced sexual activity, at least with new sexual contacts, in Sweden in 2020 [13]. Several studies from other countries have also indicated a reduced sexual activity and especially a reduced number of STI cases during the early pandemic [4, 14–22], which can also, in several countries, be partly explained by the prioritization of symptomatic more emergent STI cases [14, 23–25]. Nevertheless, some countries have reported no changes in the chlamydia or gonorrhoea incidences [26]. Additionally, not only fear as an important factor in reducing sexual contacts but also visiting STI-clinics was exposed in a study from Lisbon, Portugal exploring the effects of a lockdown on the sexual behaviour of individuals who visited a drop-in STI clinic, 78.5% of respondents reported a reduced number of sex partners [4].

According to data from the Public Health England, gonorrhoea diagnoses in England decreased by 58% from January 2020 to May 2020 and by 31% when compared from June 2019 to June 2020 [27]. Regarding diagnostic testing, a 30% decrease was seen in chlamydia, gonorrhoea and syphilis testing in England during January–June 2020 compared to the same months in 2019. Comparing only January 2020 to April 2020, testing for these bacterial STIs decreased by 71%, and then modestly increased in May–June 2020. These trends are in line with the monthly trends observed in most of the Swedish regions, but the decline in NAAT testing for chlamydia and gonorrhoea in Sweden from January 2020 to April 2020 was only 34–35% (data not shown). In England, tests accessed via Internet substantially increased from April 2020 [27], which is consistent with data from Sweden [13]. A similar impact of COVID-19 has also been seen in the United States, where the weekly number of chlamydia cases decreased by 20.2% from weeks 1–11 of 2020, that is, before the COVID-19 outbreak, to weeks 12–40. Interestingly, a decrease of only 3.0% was recorded for gonorrhoea [14].

The limitations of our study included that 2 (9.5%) of the 21 Swedish health care regions did not provide NAAT testing data, and no data regarding changes in sexual behaviour, clinical management including treatment of the STI cases (valuable especially for the patients diagnosed through the 'Internet-based' testing), or anatomical infection site(s) in each patient were available.

## CONCLUSIONS

Both the incidence of and the number of performed diagnostic NAAT tests for chlamydia and gonorrhoea significantly decreased from 2019 to 2020. However, the limited decrease in chlamydia incidence in 2020, which has been decreasing during the recent decade, was not significant when compared with the average incidence in 2017–2019. Further studies, including investigations of changes in sexual behaviour, prevention, indications for STI testing and treatment of STIs during the COVID-19 pandemic are required to elucidate the impact of COVID-19-associated social and physical distancing restrictions on sexual activity and the incidence and epidemiology of chlamydia and gonorrhoea in Sweden. Furthermore, improved and ideally more timely reported STI NAAT testing data distinguishing the 'internet-based self-sampling' testing would be valuable.

We are very grateful to all the diagnostic laboratories providing NAAT testing data.

## CONFLICT OF INTEREST

None to declare.

## FUNDING INFORMATION

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## REFERENCES

1. Schiavi MC, Spina V, Zullo MA, Colagiovanni V, Luffarelli P, Rago R, *et al*. Love in the time of COVID-19: sexual function and quality of life analysis during the social distancing measures in a group of Italian reproductive-age women. J Sex Med. 2020;8:1407–13.
2. Baral S, Rao A, Rwema JOT, Lyons C, Cevik M, Kågesten AE, *et al*. Competing health risks associated

 

with the COVID-19 pandemic and response: a scoping review. MedRxiv [Preprint]. 2021. Jan 8 [cited 2021 May 3]; Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7805463/
3. Coronavirus Death Toll and Trends - Worldometer [Internet]. [cited 2021 Sep 9]. Available from: https://www.worldometers.info/coronavirus/coronavirus-death-toll/
4. João AL, Lencastre A, Calvão J, Rodrigues A, Fernandes C. COVID-19, fear and sexual behaviour: a survey in a tertiary STI clinic in Lisbon. Sex Transm Infect 2021;97(7):549. sextrans-2020-054834. https://doi.org/10.1136/sextrans-2020-054834. Epub ahead of print.
5. Ludvigsson JF. The first eight months of Sweden's COVID-19 strategy and the key actions and actors that were involved. Acta Paediatr. 2020;109:2459–71.
6. Pashakhanlou AH. Sweden's coronavirus strategy: The Public Health Agency and the sites of controversy. World Med Health Policy. 2021. https://doi.org/10.1002/wmh3.449. Epub ahead of print.
7. Tegnell A. The Swedish public health response to COVID-19. APMIS 2021 Feb 23. https://doi.org/10.1111/apm.13112. Epub ahead of print.
8. Munskydd i kollektivtrafiken från den 7 januari — Folkhälsomyndigheten ("Face masks in public transport from 7th January (2021) - Public Health Agency of Sweden") [Internet]. [cited 2021 Feb 16]. Available from: http://www.folkhalsomyndigheten.se/nyheter-och-press/nyhetsarkiv/2020/december/munskydd-i-kollektivtrafiken-fran-den-7-januari/ [In Swedish]
9. Unemo M, Bradshaw CS, Hocking JS, de Vries HJC, Francis SC, Mabey D, *et al*. Sexually transmitted infections: challenges ahead. Lancet Infect Dis. 2017;17:e235–79.
10. Söderqvist J, Gullsby K, Stark L, Wikman M, Karlsson R, Herrmann B. Internet-based self-sampling for *Chlamydia trachomatis* testing: a national evaluation in Sweden. Sex Transm Infect. 2020;96:160–5.
11. Statistik om smittsamma sjukdomar — Folkhälsomyndigheten ("Statistics regarding communicable diseases - Public Health Agency of Sweden") [Internet]. [cited 2021 May 4]. Available from: http://www.folkhalsomyndigheten.se/folkhalsorapportering-statistik/statistik-a-o/sjukdomsstatistik/ [In Swedish]
12. Simões D, Stengaard AR, Combs L, Raben D; EuroTEST COVID-19 impact assessment consortium of partners. Impact of the COVID-19 pandemic on testing services for HIV, viral hepatitis and sexually transmitted infections in the WHO European Region, March to August 2020. Euro Surveill 2020;25:2001943.
13. Socialstyrelsen. Sexuellt överförda infektioner; påverkan av pågående coronapandemi. Fokus på klamydia och gonorré. ("National Board of Health and Welfare. Sexually transmitted infections; impact of the ongoing corona pandemic. Focus on chlamydia and gonorrhoea.") Available from: https://www.socialstyrelsen.se/coronavirus-covid-19/socialstyrelsens-roll-och-uppdrag/analys-och-utveckling/ [In Swedish]
14. Crane MA, Popovic A, Stolbach AI, Ghanem KG. Reporting of sexually transmitted infections during the COVID-19 pandemic. Sex Transm Infect. 2021;97:101–2.
15. de Miguel Buckley R, Trigo E, de la Calle-Prieto F, Arsuaga M, Díaz-Menéndez M. Social distancing to combat COVID-19 led to a marked decrease in foodborne infections and sexually transmitted diseases in Spain. J Travel Med. 2020;27(8):taaa134.
16. Gillespie D, Knapper C, Hughes D, Couzens Z, Wood F, de Bruin M, *et al*. Early impact of COVID-19 social distancing measures on reported sexual behaviour of HIV pre-exposure prophylaxis users in Wales. Sex Transm Infect. 2021;97:85–7.
17. Hensel DJ, Rosenberg M, Luetke M, Fu T, Herbenick D. Changes in solo and partnered sexual behaviors during the COVID-19 pandemic: findings from a U.S. Probability Survey [Internet]. Sex Reprod Health. 2020; https://doi.org/10.1101/2020.06.09.20125609
18. Latini A, Magri F, Donà MG, Giuliani M, Cristaudo A, Zaccarelli M. Is COVID-19 affecting the epidemiology of STIs? The experience of syphilis in Rome. Sex Transm Infect. 2021;97(1):78.
19. Maatouk I, Assi M, Jaspal R. Emerging impact of the COVID-19 outbreak on sexual health in Lebanon. Sex Transm Infect. 2020;97(4):318.
20. Rodriguez I, Hernandez Y. Sexually transmitted diseases during the COVID-19 pandemic: a focus on syphilis and gonorrhoea in Cuba. Public Health Pract. 2021;2:100072.
21. Sacchelli L, Viviani F, Orioni G, Rucci P, Rosa S, Lanzoni A, *et al*. Sexually transmitted infections during the COVID-19 outbreak: comparison of patients referring to the service of sexually trans-mitted diseases during the sanitary emergency with those referring during the common practice. J Eur Acad Dermatol Venereol. 2020;34:e553–6.
22. Whitlock GG, McOwan A, Nugent D. Dean Street Collaborative Group. Gonorrhoea during COVID-19 in London, UK. Sex Transm Infect. 2021; https://doi.org/10.1136/sextrans-2020-054943. Epub ahead of print.
23. Cusini M, Benardon S, Vidoni G, Brignolo L, Veraldi S, Mandolini PL. Trend of main STIs during COVID-19 pandemic in Milan, Italy. Sex Transm Infect. 2021;97(2):99.
24. Chow EPF, Hocking JS, Ong JJ, Phillips TR, Fairley CK. Sexually transmitted infection diagnoses and access to a sexual health service before and after the national lockdown for COVID-19 in Melbourne, Australia. Open Forum Infect Dis. 2021;8:ofaa536.
25. Nagendra G, Carnevale C, Neu N, Cohall A, Zucker J. The potential impact and availability of sexual health services during the COVID-19 pandemic. Sex Transm Dis. 2020;47:434–6.
26. Kuitunen I, Ponkilainen V. COVID-19-related lockdown did not reduce the reported diagnoses of *Chlamydia trachomatis* and *Neisseria gonorrhoeae* in Finland. Sex Transm Infect. 2021;97:50. https://doi.org/10.1136/sextrans-2020-054881
27. Ratna N, Mitchell H, Vilaplana T, Harb A, Glancy M, Shah A, *et al*. COVID-19: impact on STIs, HIV and viral hepatitis [Internet]. GOV.UK. [cited 2021 Jan 20]. Available from: https://www.gov.uk/government/publications/covid-19-impact-on-stis-hiv-and-viral-hepatitis

 