SARS-CoV-2 seroprevalence study after the first wave among persons living and working in an overcrowded Swiss prison

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Abstract

Purpose. Prisons can be epicenters of infectious diseases. However, empirical evidence on the impact of the SARS-CoV-2 pandemic in prison is still scarce. This study estimated the seroprevalence rates of anti-SARS-CoV-2 in the largest and most crowded Swiss prison and compared them with the seroprevalence rate in the general population.

Design/methodology/approach. A cross-sectional study was conducted in June 2020, one month after the first wave of SARS-CoV-2 in Switzerland. Groups included: 1) people living in detention (PLDs) detained before the beginning of the pandemic (n=116), 2) PLDs incarcerated after the beginning of the pandemic (n=61), 3) prison staff and prison healthcare workers (n=227), and 4) a sample from the general population in the same time period (n=3,404). We assessed anti-SARS-CoV-2 IgG antibodies.

Findings. PLDs who were incarcerated before the beginning of the pandemic had a significantly lower seroprevalence rate (0.9%, IC95%: 0.1%-5.9%) compared to the general population (6.3%, IC95%: 5.6-7.3%) (p=.041). The differences between PLDs who were incarcerated before and other groups were marginally significant (PLDs incarcerated after the beginning of the pandemic: 6.6%, IC95%: 2.5%-16.6%, p=.063; prison staff: 4.8%, 2.7%-8.6%, p=.093). The seroprevalence of prison staff was only slightly and non-significantly lower than that of the general population.

Originality. During the first wave, despite overcrowding and interaction with the community, the prison was not a hotspot of SARS-CoV-2 infection. Preventive measures probably helped avoiding clusters of infection. We suggest that preventive measures that impact social welfare could be relaxed when overall circulation in the community is low, to prevent the negative impact of isolation.

Keywords. COVID-19; detention; public health; COVID-19 serological testing.

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Introduction

Prisons can be epicenters of various infectious diseases due to a combination of risk factors favoring transmission, including barriers to implement social distancing related to overcrowding (Kinner et al., 2020). To date, many prisons have reported a high prevalence rate of SARS-CoV-2 and overcrowding is associated with increased incidence rates of COVID-19 (Leibowitz et al., 2021, Duque et al., 2022, Kennedy et al., 2020, Kronfli et al., 2022, Silva et al., 2021). By 18 May 2021, 2,680 COVID-19 deaths were reported in US prisons (Hagan et al., 2020, The Marshall Project, 2021). In some prisons, up to 70% of people living in detention (PLDs) have contracted COVID-19.

In addition to their high risk of infection by SARS-CoV-2 due to the characteristics of the prison context, PLDs have a higher incidence of health conditions, including risk factors for SARS-CoV-2 infection severity, thereby increasing their overall vulnerability (Fazel and Baillargeon, 2011, Hawks et al., 2020, Kinner et al., 2020). The need to limit the magnitude of SARS-CoV-2 outbreaks in prisons is therefore critical to prevent the overburden of prison and community health services (Kinner et al., 2020). SARS-CoV-2 infection in prison can occur in various ways, including via PLDs (who are sick or in the incubation phase) at their initial entry or when returning to the institution (e.g., after temporary leaves, court trials, visits to the hospital), and outside persons with contact with the PLDs (e.g., prison staff, visitors, and lawyers). The measures recommended for the control of COVID-19 in prison aim to limit the transmission of the virus from the outside world into prison, to limit the propagation of the virus within prisons, and to reduce the number of infected persons released into the community (Franco-Paredes et al., 2020).

Nevertheless, social isolation linked to physical distancing measures, like the suspension of visits and activities during the spring 2020 lockdown, might exacerbate the anxiety linked to the pandemic and resulted in an increase in mental health and behavioral problems, within a population already facing a high rate of mental health disorders (Fazel et al., 2016). In Italy and many other countries, fears of COVID-19 and over-isolation resulting from drastic control measures led to violent riots and deaths during the first wave (Caputo et al., 2020). In the Swiss prison where this project was carried out, a study showed that suicide attempts increased by 57% during the pandemic period. This increase may be related to COVID-19 control measures (Gétaz et al., 2021). Thus, a balance must be found between strict containment measures and the maintenance of possibilities of contact with the outside world and living conditions that preserve the mental health of this vulnerable population(Hewson et al., 2020, Stewart et al., 2020).

The aim of this study was to estimate the seroprevalence rates of PLDs who became infected during the first wave of SARS-CoV-2 in Switzerland (Spring 2020), using a seroprevalence study among PLDs and prison staff. This study is important for comparative purposes, as no previous study compared seroprevalence rates with a general population sample in the same period. It would also improve COVID-related strategies and decision making on preventive measures in prison.

Methods

Setting and prison context

Data were collected in Champ-Dollon, the largest pre-trial prison located in the French-speaking part of Switzerland, with 304 cells and a capacity of 398 places. The facility is constantly overcrowded, with 634 PLDs (159%) by the end of February 2020 and 495 (124%) on average in June 2020 (on average, 175% between 2013 and 2018). The exact composition

of cells was not available. Less than 10% of PLD were in single cells, the others cells ranging from two to six PLD per cell. Turnover is also high, with an average rate of 273%, between 2013 and 2018. In addition, an average of 650 people (e.g., detention officers, health care professionals, lawyers, visitors, delivery personnel) enter the prison each day.

In the canton of Geneva, there was a high prevalence rate of COVID-19 during the first wave, but most inhabitants remained uninfected (Stringhini et al., 2020). From the beginning of March 2020, control measures were implemented to manage overcrowding, to ensure that detained persons and staff respected recommended measures and to detect early SARS-CoV-2 cases. Table 1 presents the control measures applied in the Champ-Dollon prison. Those measures were in line with international recommendations (Cpt, 2020, Who, 2020) and aimed to provide a balance between public health issues, safety considerations, and human rights.

Sample and procedures

A repeated cross-sectional study was conducted in June 2020. Recruitment began three weeks after the end of the first wave (May 2021) (Stringhini et al., 2020). A nurse or a physician offered a blood test to 240 randomly selected PLDs and to the whole prison staff. A random selection of PLD was made for each prison's floor. No policy of allocation of cells exists, so the random selection reflects the whole prison population. Detained persons were separated in two groups: Those incarcerated before the beginning of the pandemic (March 1st, 2020) and those incarcerated after. In addition, a comparison group from the general population of Geneva, Switzerland, who completed the survey in June 2020 was included. Participants were randomly selected (yearly representative stratified sample). This latter study is described in Stringhini et al. (Stringhini et al., 2020) and in Richard et al. (Richard et al., 2021).

Consent form and questionnaires were developed in seven languages. All participants gave written informed consent before study participation. The study was approved by the Cantonal Research Ethics Commission of Geneva, Switzerland (CCER 2020-00932).

For PLDs, we sampled six drops of capillary blood (Labonovum device), collecting about 100 µl after centrifugation. We used capillary blood collection to maximize the participation rate, as PLDs are often reluctant to venous blood sampling. In the community, we took two samples of 3 mL of peripheral venous blood.

Laboratory analysis

We assessed anti-SARS-CoV-2 IgG antibodies using a commercially available ELISA (Euroimmun; Lübeck, Germany #EI 2606-9601 G) targeting the S1 domain of the spike protein of SARS-CoV-2. The quantification of antibodies by this method showed a good correlation with the presence of anti-SARS-CoV2 antibodies measured by immunofluorescence and total immunoglobulins that targets the nucleocapsid antigen measured by electrochemiluminescence (ECLIA; Roche Diagnostics, Rotkreuz, Switzerland). Serological testing was performed according to the instructions from the manufacturer.

Variables

We collected sociodemographic variables for the study's purposes (age and gender).

Statistical analysis

At the time the protocol was written, which was done very early in the pandemic, there was no data were available to compute a sample size. This study should therefore be considered as exploratory.

We present the seroconversion rate in each group, along with 95% confidence intervals (CI). We did not adjust for test performance or population structure. The four groups (i.e., PLDs before pandemic, PLDs after pandemic, prison staff, and general population) were compared using a logistic regression, with PLDs incarcerated before the beginning of the pandemic as the reference group. We also computed pairwise comparisons between other groups (PLDs after pandemic, prison staff, and community). No imputation was made for missing values. We computed two sensitivity analyses using subsamples of the general population and prison staff. We first excluded women and people aged more than 67, as PLDs were exclusively men with age max. = 67. We then matched participants from the general population and prison staff to PLDs on age and gender and performed conditional logistic regression models. P-values <.05 were considered as significant and between .05 and .1 as marginally significant. Analyses were performed with Stata 16.

Results

A total of 240 PLDs were invited to participate, with a response rate of 74% (n=177, with n=116 PLDs incarcerated before the beginning of the pandemic and n=61 after). Out of 350 prison staffs invited, n=227 accepted (response rate = 65%). The comparison group from the community included n=3,404 individuals.

The seroprevalence rates were 0.9% (1/116; 95% CI: 0.1%-5.9%) among PLDs who were incarcerated before the pandemic, 6.6% (4/61; 95% CI: 2.5%-16.6%) among PLDs incarcerated after the beginning of the pandemic, 4.8% (11/227; 95% CI: 2.7%-8.6%) for the prison staff, and 6.3% (216/3404; 5.6%-7.3%) among the community group (see Figure 1).

The single case infected who had been in prison since before the pandemic reported no symptoms suggestive of COVID-19. This PLD was an isolated patient, incarcerated in a single cell, who possibly contracted SARS-CoV-2 infection through contacts with prison staff. Of the

four positive cases incarcerated after the onset of the pandemic, two reported no symptoms consistent with COVID-19 and two reported symptoms consistent with COVID-19 prior to incarceration. None had PCR testing prior to incarceration.

PLDs incarcerated before the beginning of the pandemic had a significantly lower seroprevalence rate compared to the community group (p=.041). The differences between PLDs who were incarcerated before and after the beginning of the pandemic was marginally significant (p=.063). The difference between PLDs incarcerated before the beginning of the pandemic and the prison staff was also marginally significant (p=.093). The seroprevalence of prison staff was only slightly and non-significantly lower than that of the general population.

In the sensitivity analysis restricting the sample to men aged 67 or less, the seroprevalence rates for the general population (n=1,098) and prison staff (n=159) were 6.9% (95% CI: 5.6%-8.6%) and 5.1% (95% CI: 2.6%-9.8%). Comparisons of PLDs who were incarcerated before the pandemic with other groups were similar as those reported above: significant with the general population (p=.034) and marginally significant with PLDs who were incarcerated after the beginning of the pandemic (p=.062) and prison staff (p=.089). In the sensitivity analysis matching participants from the general population and prison staff to PLDs on age and gender, results were also similar. The seroprevalence rates for the general population (n=177) and prison staff (n=109) were 9.6% (95% CI: 6.1%-14.9%) and 5.5% (95% CI: 2.5%-11.7%). Comparisons of PLDs who were incarcerated before the pandemic with other groups were significant with the general population (p=.016) and marginally significant with PLDs who were incarcerated after the beginning of the pandemic (p=.062) and prison staff (p=.081).

Discussion

This seroprevalence study showed that people living and working in an overcrowded Swiss prison did not have higher seroprevalence rates of anti-SARS-CoV-2, when compared to the

general population. Contrary to what might be expected, being incarcerated was rather a protective factor. Persons incarcerated before the first wave of the pandemic were less infected than those living in the community and incarcerated later. This result differed from the findings in other countries, where the disease had a larger impact. For example, in prisons located in the Massachusetts, when crowding exceeded 100% of the prison capacity, the incidence of SARS-CoV-2 was five times higher compared with a crowding lower than 70%. These findings included prisons without dormitory housing and where an important proportion of PLD were housed in individual cells (Leibowitz et al., 2021). In our study, although the overcrowding rate ranged from 124% to 159% during the first wave, the incidence of SARS-CoV-2 was low. Also in the United States, by the time our study was conducted, the incidence rate was five times higher in prison than in the community (Saloner et al., 2020). These differences could be explained by heterogeneity in control measures and varying degrees of crowding between prisons. However, this can also be related with the appropriate timely measures put in place in Swiss prison, thereby reducing the spread of the infection.

Indeed, despite the continuity of face-to-face meetings with families and lawyers and the fact that one professional working in the prison out of 20 got infected, the control measures applied in this prison have probably limited the infection of PLDs. Measures included inviting symptomatic PLDs to undergo screening, isolating positive cases, quarantining significant contacts, while applying the control measures to all those living in the prison.

For prison staff, working in detention during the first wave did not lead to an increased risk of infection compared to the general population. While the general population was confined at home for five weeks, with measures gradually lifted since mid-April 2020, the prison staff was not confined, maintaining many professional contacts to carry out their essential mission. These findings also encourage the application of control measures in prison.

In addition, the results suggest that PLDs can be protected from SARS-CoV-2 infection in overcrowded facilities, even if control measures do not guarantee that an intramural epidemic could be avoided.

The balance must be found between the need to prevent SARS-CoV-2 infection and COVID-19 disease and the need to preserve mental health, as evidenced by the increase in suicide attempts during the pandemic period in the study population (Gétaz et al., 2021). In this context, we recommend that efforts must be made to optimize the rate of vaccination coverage in detention, to partially release some of the restrictions that impact social and psychological welfare. Nevertheless, relaxing measures must be made cautiously, according to the transmission rate which fluctuates over time, with strict enforcement of measures only during epidemic peaks.

This study has some limitations. First, we should keep in mind that some comparisons were marginally significant. It might be because some groups were rather small, limiting the power of the study. Larger sample sizes are required to confirm our findings. Second, we considered the seroprevalence rate without adjusting for test performance and characteristics of the population. As characteristics of PLDs vary from prison to prison and are not well described, it was not possible to adjust for them. However, the performance of the test was the same for all groups considered in the analyses, so it was unlikely to create bias. Future studies should consider the length of incarceration to investigate whether duration of detention is associated with the probability of being infected.

Conclusion

Overall, during the first wave of the pandemic, despite the overcrowded conditions of the studied prison and its high level of interaction with the community, the prison was not a hotspot of SARS-CoV-2 infection. This was probably due to the control measures implemented with

priority given to reducing overcrowding, promotion of compliance with control measures, and early case detection and case management (Gonçalves et al., 2021). The studied prison can be taken as a good example on preventing widespread infection, which has been a challenge in prisons worldwide.

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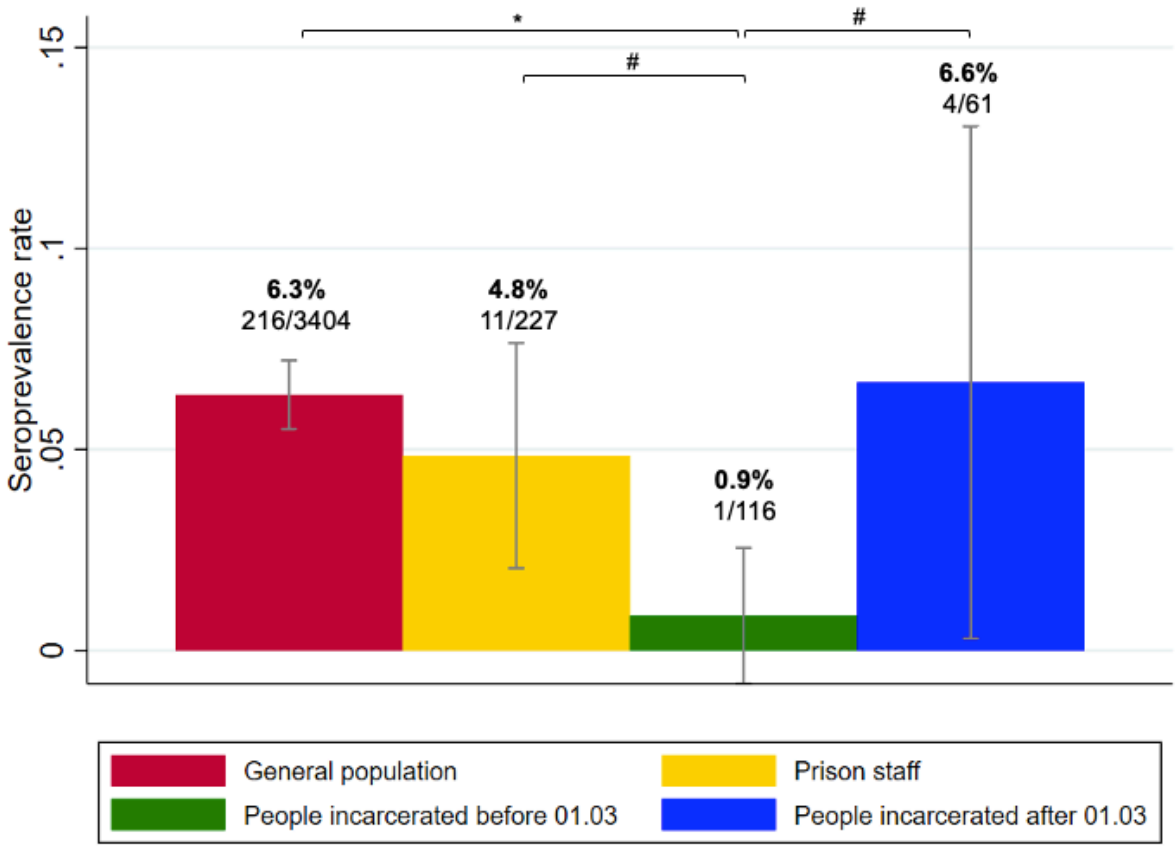
Table 1. Control measures of COVID-19 implemented at the Champ-Dollon prison, Geneva, Switzerland

Type of measures	**Specific action**
Reduction of overcrowding	Release or postponement in case of minor offences strongly encouraged
	Transfer of some clinically vulnerable PLDs to non-overcrowded prisons
Promote compliance with barrier measures (physical distance, use of masks, washing hands)	Information in several languages through videos on the internal TV channel, distribution of flyers in several languages and during small group meetings of PLDs with detention officers and healthcare workers
	Provision free of charge of masks, soap, and hydro-alcoholic solution
Early case detection and case management	Nasopharyngeal swabs (PCR) if any symptoms in PLDs and staff
	Isolation of infected persons and quarantine of contact persons
Additional prison measures	Closing of workshops not essential for the functioning of the prison
	Multi-daily cleaning of surfaces and door handles
	Sport maintained, but ball and contact sports abolished; daily walking in groups of maximum 30 PLDs (in non-epidemic periods approximatively 60 PLDs)
	Isolation of all arrivals for 11 days (incubation period of 97.5% of cases)
	Most visits are maintained, but with adaptation of the infrastructure by installing Plexiglas windows and turning away visitors with SARS-CoV-2 compatible symptoms
	Compensatory measures (free of charge phone calls) to limit frustration

Figure 1. Seroprevalence rate of anti-SARS-CoV2 antibodies among persons living in detention, professionals working in prison and general population. Geneva, Switzerland, June 2020.



* p<.05

# p<.10