

Short report

Occupational risk of SARS-CoV-2 infection and reinfection during the second pandemic surge: a cohort study

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ABSTRACT

Objectives This cohort study including essential workers, assessed the risk and incidence of SARS-CoV-2 infection during the second surge of COVID-19 according to baseline serostatus and occupational sector.

Methods Essential workers were selected from a seroprevalence survey cohort in Geneva, Switzerland and were linked to a state centralised registry compiling SARS-CoV-2 infections. Primary outcome was the incidence of virologically confirmed infections from serological assessment (between May and September 2020) to 25 January 2021, according to baseline antibody status and stratified by three predefined occupational groups (occupations requiring sustained physical proximity, involving brief regular contact or others).

Results 10 457 essential workers were included (occupations requiring sustained physical proximity accounted for 3057 individuals, those involving regular brief contact, 3645 and 3755 workers were classified under 'Other essential occupations'). After a follow-up period of over 27 weeks, 5 (0.6%) seropositive and 830 (8.5%) seronegative individuals had a positive SARS-CoV-2 test, with an incidence rate of 0.2 (95% CI 0.1 to 0.6) and 3.2 (95% CI 2.9 to 3.4) cases per person-week, respectively. Incidences were similar across occupational groups. Seropositive essential workers had a 93% reduction in the hazard (HR of 0.07, 95% CI 0.03 to 0.17) of having a positive test during the follow-up with no significant between-occupational group difference.

Conclusions A 10-fold reduction in the hazard of being virologically tested positive was observed among anti-SARS-CoV-2 seropositive essential workers regardless of their sector of occupation, confirming the seroprotective effect of a previous SARS-CoV2 exposure at least 6 months after infection.

INTRODUCTION

The occupational risk of SARS-CoV-2 reinfection is incompletely understood. Large observational studies,^{1 2} especially among healthcare workers (HCWs),³ found that natural infection elicits protective immunity with a 10-fold reduction of

Key messages

What is already known about this subject?

► Risk of SARS-CoV-2 reinfection is low in the general population and among healthcare workers.

What are the new findings?

► A 10-fold reduction of risk of being virologically tested positive reinfection is observed among anti-SARS-CoV-2 seropositive essential workers of different activity sectors, regardless of their occupation-related risk of exposure.

How might this impact on policy or clinical practice in the foreseeable future?

► Vaccination could be delayed in individuals with previous history of SARS-CoV-2 infection with serological confirmation, regardless of their occupational exposure. These observations need to be confirmed for new SARS-CoV-2 variants.

reinfection risk. Essential workers were unequally affected in the early phases of the pandemic, with HCWs being at higher risk of contracting infections,^{4 5} and a wide variability in seropositivity across occupations.⁶ Close contact and inadequate personal protective equipment have been identified as risk factors,⁷ generating a large deployment of social distancing and barrier measures. Despite this, a second pandemic surge affected most countries worldwide, taking place at the end of 2020 in Switzerland. To face it, authorities in Geneva reintroduced partial lockdown policies, mandating home working and interrupting non-essential activities (online supplemental figure S1). As during the first lock down, these measures did not affect essential workers, whose occupations are considered indispensable for the society, such as workers in the healthcare, social work and transportation sectors. Workers in these sectors may face a higher risk of infection.⁸ During the first surge, HCWs were at higher risk of infection but it remains unknown whether it is still the case with growing evidence

that personal protective measures are effective,⁹ and if it also applies to the risk of reinfection. Little is known about the other essential occupations. We aimed, therefore, to investigate the protective effect conferred by previous infection, added and compared with the usual protective measures, in occupational groups with variable exposure risk. In this study, we assessed the risk of virologically-confirmed SARS-CoV-2 infection during the second pandemic surge in a large cohort of essential workers from 32 occupations according to their baseline serostatus and occupational group.

METHODS

Participants were selected from a serosurvey cohort recruiting essential workers between May and September 2020 in Geneva, Switzerland.⁶ Data of SARS-CoV-2 infections were extracted from a centralised state registry and linked to each participant, as previously described.² Workers were categorised into three predefined groups, according to their exposure risk: occupations likely requiring sustained physical proximity to other individuals (eg, HCW, childcare and social workers), occupations involving regular brief contact (eg, pharmacists, taxi drivers, grocery workers) and other essential occupations (eg, farmers, managers and health researchers) (online supplemental table S1). Participants were classified as seropositive or seronegative according to their serological status at recruitment (decisional algorithm available in online supplemental material). SARS-CoV-2 infections were confirmed by reverse transcriptase PCR (RT-PCR) or antigenic rapid diagnostic test (Ag RDT) on nasopharyngeal swabs.² Positive RT-PCR or Ag RDT in seropositive individuals was clinically investigated by two independent adjudicators and classified as likely or unlikely reinfections. To note, no vaccine doses were available in Geneva during the study period.

Outcomes

The primary outcome was the incidence of virologically confirmed infections during study follow-up (ie, from serological assessment to 25 January 2021) according to the baseline antibody status and stratified by occupational group. Secondary outcomes were incidence of testing and proportion of positive tests.

Statistical analysis

Incidence rates of infection were estimated in each study group. The adjusted HR of having a virologically confirmed infection in seropositive compared with seronegative participants was estimated with the Cox's proportional hazard model. Variables having been previously associated to the risk of infection¹⁰ were included in the Cox's model (age, sex, smoking status, obesity and formal educational level). Survival curves were presented using the Kaplan-Meier method and stratified by occupational group. Interaction between occupational group and serological status was tested with the likelihood ratio test. Consistency of results was assessed with the leave-one-out method where HRs were computed by leaving each occupation out. Workers living outside the canton of Geneva, who may be tested at their living place, were excluded in a sensitivity analysis.

RESULTS

In total, 10 582 essential workers from 32 occupations were included in the study cohort between May and September 2020 (57% and 55.6% of women and mean age of 43.9 and 44.5 years old for seropositive and seronegative individuals, respectively) (online supplemental tables S1 and S2). After exclusion of 125

participants with missing data in covariables or outside the target age of 18–65 years old, occupations involving physical proximity accounted 3057 individuals, those involving regular customer contact 3645 individuals, and the others essential occupations 3755 individuals (online supplemental figure S2). Workers living in Geneva represented 57.5% of the study sample and were unequally distributed across occupational groups (online supplemental table S3). The follow-up period did not differ significantly between seropositive and seronegative participants, being 27.6 weeks (SD 5.2) and 27.9 (SD 5.1), respectively ($p=0.061$). On average, both seropositive and seronegative participants had 1.3 SARS-CoV-2 tests per individual during the study period with no differences between occupational groups (online supplemental table S3 and S3). Five (0.6%) seropositive and 830 (8.5%) seronegative individuals had a positive virological SARS-CoV-2 test during the follow-up period. This corresponds to an incidence rate of 0.2 (95% CI 0.1 to 0.6) and 3.2 (95% CI 2.9 to 3.4) person-week for seropositive and seronegative individuals, respectively (online supplemental table S2). Incidences were similar across occupational groups (online supplemental table S3). All infections in seropositive individuals were considered likely reinfections by adjudicators (online supplemental table S4).

Reinfection risk

Seropositive essential workers had a 93% reduction in the hazard of having a positive virological SARS-CoV-2 test compared with those who were seronegative at baseline (HR of 0.07, 95% CI 0.03 to 0.17). No significant between-group difference was noted when stratifying by occupational group, the HR being 0.07 (95% CI 0.02 to 0.29) for occupations requiring physical proximity, 0.05 (95% CI 0.01 to 0.33) for occupations with regular customer contact, and 0.09 (95% CI 0.02 to 0.40) for other essential occupations (figure 1 and online supplemental table S5), $P_{\text{interaction}}=0.85$). Results were consistent in the leave-one-out sensitivity analysis (online supplemental figure S3), in subgroups of age (online supplemental table S7), sex (online supplemental table S8) and in the subsample of participants living in the canton of Geneva (HR 0.04, 95% CI 0.01 to 0.14, (online supplemental table S6).

DISCUSSION

In this cohort study covering a period of over 27 weeks, a 93% reduction in the hazard of being virologically tested positive, was observed among anti-SARS-CoV-2 seropositive essential workers, compared with their seronegative counterparts, regardless of their sector of occupation and thus of the intensity of potential reexposure. This result is consistent with our report of a 94% risk reduction 35 weeks after serological assessment in a previous cohort of the Geneva general population,² as well as with a large retrospective analysis of RT-PCR results of the Danish population observing over 80% protection in the total study population and in the subgroup of HCW.¹ HCWs have been the focus of reinfection studies since they experienced higher rate of infections at the beginning of the pandemic.¹¹ Based on these observations, HCWs have been prioritised by vaccination policies, even if already been infected. Other occupations, however, such as waiters and taxi drivers, were possibly at higher risk for infection than HCW during the second phase of pandemic.¹² This study observed a similar incidence of infection in seronegative individuals across occupational groups with variable exposure risk, suggesting the effectiveness of universal implementation of personal protection policies. Moreover,

Workplace

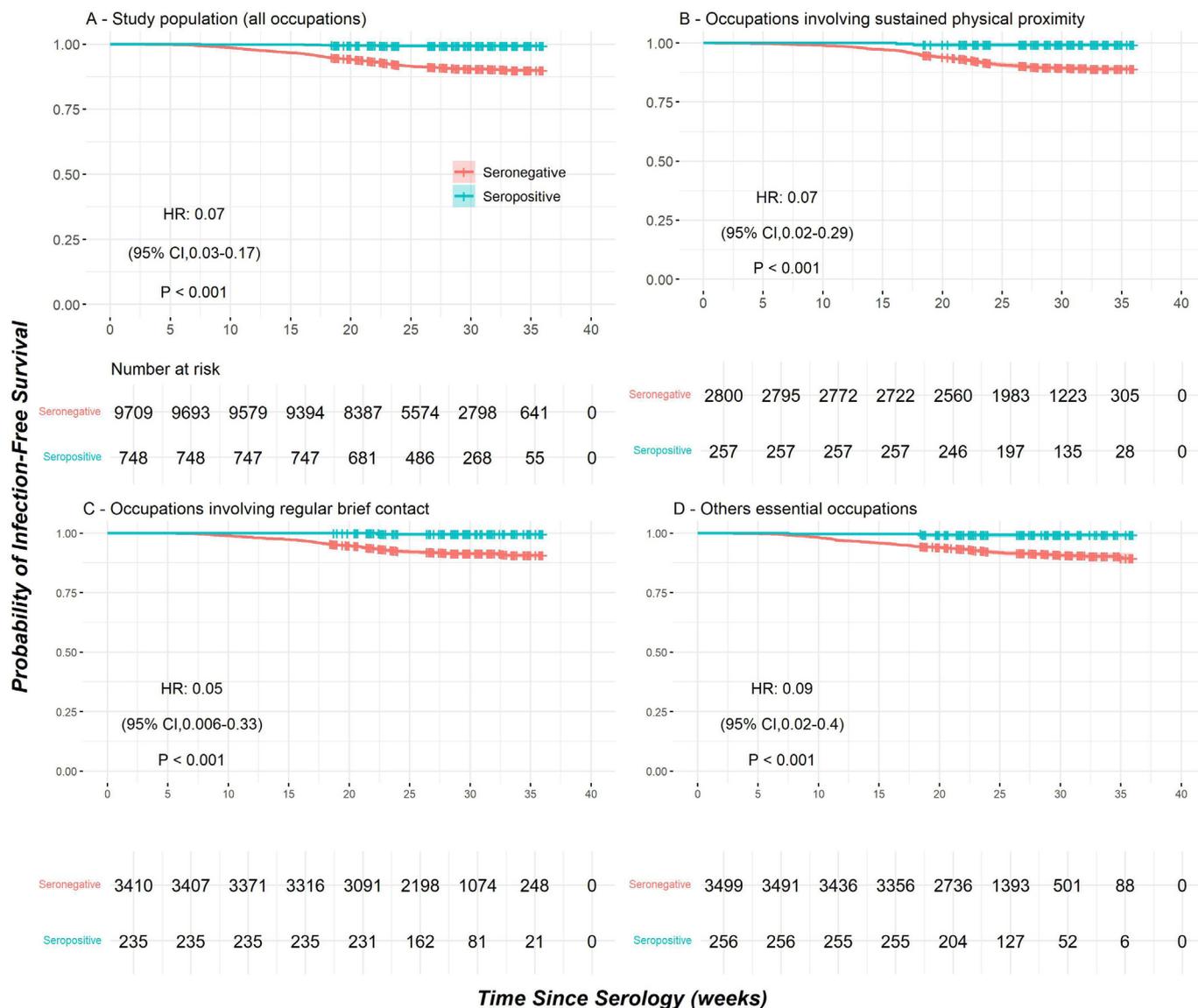


Figure 1 Infection-free survival according to serostatus in the study population (A) and in subgroups of occupations (B, C, D).

we observed a similar reinfection rate across the occupational groups, suggesting protection against reinfection, regardless of the various degree of exposure.

The study has some limitations. First, essential workers were categorised into three prespecified groups, based on previous reports on exposure risk, though these groupings are imperfect and may not entirely reflect exposure nor between-workers and out-of-work exposures.⁴ Nevertheless, no differences in results were observed in our post hoc misclassification sensitivity analysis (online supplemental figure S4). Second, our sample was composed by a significant proportion of cross-border workers, possibly being tested outside Geneva. Similar results, however, were observed when border workers were excluded (HR 0.04, 95% CI 0.01 to 0.14). Third, participants of the SEROCO-V-WORK+ were included on a voluntary basis, and selection towards participants better aware of sanitary measures might have occurred, potentially underestimating reinfection risk and limiting generalisability of results. Finally, we cannot infer cross-protection against new SARS-CoV-2 variants because they were underrepresented during the study period.

This study has several important strengths. First, serological status assessment occurred in the early phases of the pandemic

allowing a longitudinal follow-up covering the second pandemic surge. Second, this study took place before vaccination era, consenting us to properly evaluate the protective effect conferred by natural infection. Third, a large number of essential occupations were represented, providing information outside the healthcare sector. Finally, study results were concordant in all sensitivity analyses raising robustness of our observations.

In conclusion, we observed no significant differences in documented SARS-CoV-2 infections and reinfections across mobilised workers from a variety of occupational categories. Our results build up on the growing evidence about the seroprotective effect of antibodies at least 6 months after infection.

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Contributors The idea for the study originally came from AL. AL and AB carried out the literature search. AL, AB, SS, IG, RDum, RDub, ASA and MEZ conceptualised and designed the study. GP and DSC oversaw database linkage. AB and FK conducted clinical investigations. RDum and RDub did data analysis. AL, AB, SS and ASA wrote the first draft of the manuscript. All authors have read, critically revised and approved the final version of this manuscript. AL and AB, SS and IG contributed equally to this paper.

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