Peer Review Report

Review Report on Socioeconomic differences in SARS-CoV-2 infection and vaccination in Germany: a seroepidemiological study after one year of COVID-19 vaccination campaign

Original Article, Int J Public Health

EVALUATION

Q 1   **Please summarize the main findings of the study.**

In this study, the authors have explored the link between individuals' economic status and their history with COVID-19, specifically their past infection and vaccination records. The findings indicate that individuals with a lower socioeconomic position (SEP) had a greater risk of contracting SARS-CoV-2 infection. On the other hand, multiple COVID-19 vaccine doses or hybrid immunity a combination of infection and vaccination were associated with a higher SEP. This suggests that socioeconomically disadvantaged groups may face a higher vulnerability to severe COVID-19 compared to socioeconomically better-off groups.

Q 2   **Please highlight the limitations and strengths.**

Strengths
– This is a population-based study involving more than 10,000 participants.
– The authors used three different indicators to define contact with COVID-19: a history of SARS-CoV-2 infection, vaccination against COVID-19, and hybrid immunity. The use of these indicators allow for a better understanding of individual behaviour, lifestyle factors, and genetic factors in relation to COVID-19.
Limitations
– Studying the socio-economic differences in the face of the Covid-19 epidemic is very interesting. I am somewhat disappointed with the choice of the two socio-economic indicators used in the study. I would have appreciated if the authors had further explored the data at their disposal.
– Furthermore, it is not clear to me whether the authors have specified whether the self-reported data on SARS-COV-2 infections or COVID-19 vaccinations are self-reported or verified by antigen tests.

Q 3   **Please provide your detailed review report to the authors. The editors prefer to receive your review structured in major and minor comments. Please consider in your review the methods (statistical methods valid and correctly applied (e.g. sample size, choice of test), is the study replicable based on the method description?), results, data interpretation and references. If there are any objective errors, or if the conclusions are not supported, you should detail your concerns.**

The manuscript is very clear and very well presented.
Several limitations are listed by the authors in the discussion but my main concerns are the following.
The authors used a serological test that allowed the assessment of antibodies against the spike protein (anti-S) and the nucleocapsid protein (anti-N) of SARS-CoV-2 allowing, in principle, to identify individuals with past infection even if they were vaccinated against COVID-19 (at least for mRNA-based vaccines). Additionally, the authors used self-reported data from participants regarding their history of SARS-CoV-2 infection. The combined use of these two data collection methods is very interesting and could, for example, help identify unknown infections. However, the definition of the three COVID-19 outcomes (infection, vaccination, hybrid immunity) is not clear to me. Here are my main concerns:
– The authors used the Euroimmun ELISA but did not provide information regarding the sensitivity and specificity of this test. Could you please provide more information on this matter. As for the adaptation of the

cut-off, the authors declared adjusting it for their study. Unfortunately, without further information, it is unclear how they defined and validated the cutoff used in this study.

– The blood test being a rather invasive procedure, I wonder what percentage of the study population agreed to participate in this test? Do you have a high participation rate? What measures did you implement to motivate people to participate?

– The authors define SARS-CoV-2 infection as " having any self-reported previous PCR-confirmed infection, seropositivity for anti-N or, in absence of self-reported vaccination, for anti-S." Can the authors explain when self-reported data or seropositivity data were used to define a SARS-CoV-2 infection? Were self-reported infections verified with seropositivity? How did you handle participants who reported an infection but did not show antibodies with the serological test?

– The variable 'having being vaccinated' was defined as having received at least one dose of vaccine based on self-reported data. Why wasn't data from serological tests also used?

– Another concern is that the authors did not take into account time since vaccination and it is well known that the antibody levels decrease over time. Can you explain how the time between vaccination and serological testing was taken into account in your study?

– Was the entire population vaccinated with the same type of vaccine? Do you know if other types of vaccine were administered? If so, were you able to differentiate the presence of antibodies according to the vaccines used?

– Given that the booster dose was administered in December 2021, right in the middle of your study, do you know how many people opted for a booster dose? did this have any influence on your results?

– What percentage of the study population is unvaccinated?

Could the authors provide more information about the 'weight' calculation? How did you manage the missing data? Do you have check the self-reported data with some other official data (i.e. national vaccination database)?

For this study, the authors chose two indicators to explore the link between socioeconomic status and the history with COVID-19. Given the uniqueness of this pandemic and its impact on individuals' lifestyles, did the authors consider other factors such as employment status: temporary unemployment due to the pandemic, healthcare workers, or individuals who were unable to work remotely during the pandemic? Did they consider the number of children/people living in the same household? These pieces of information could help us better understand the results and provide some explanations (unequal exposure, unequal transmission, unequal susceptibility). The authors chose to use education level and household income as measures of socioeconomic position. Can you explain the rationale behind using (only) these indicator?

Regarding the statistical analyses, the authors stated that they adjusted the results for some factors. Did the authors take also into account the presence of chronic diseases? It is known that the presence of a chronic disease can have an influence on COVID-19 history. Individuals with a chronic disease are more likely to contract an infection or develop a severe form of the disease. Did the authors take also into account the presence of chronic diseases? In this context, it would be important to know if you included the presence of chronic diseases among these adjustment factors. By including this variable in the analyses, the authors would be able to determine if the associations between socioeconomic status and the history with COVID-19 are influenced by the presence of chronic diseases. This would also allow for a better assessment of the impact of pre-existing health on the study results and to determine if the observed associations are primarily due to socioeconomic factors or health-related factors.

PLEASE COMMENT

Q 4 Is the title appropriate, concise, attractive?

Yes. However, I'm still waiting to see how the authors actually accounted for the presence of antibodies based on serological tests. It is not clear in the manuscript whether they primarily relied on self-reported data (infection/vaccination) or test results.

If the authors prioritized self-reported data, the title should be modified accordingly.

Q 5 Are the keywords appropriate?

yes, I would also add Covid-19

Q 6   **Is the English language of sufficient quality?**

Yes

Q 7   **Is the quality of the figures and tables satisfactory?**

Yes.

Q 8   **Does the reference list cover the relevant literature adequately and in an unbiased manner?)**

yes

QUALITY ASSESSMENT

Q 9   **Originality** — 4/5

Q 10   **Rigor** — 4/5

Q 11   **Significance to the field** — 4/5

Q 12   **Interest to a general audience** — 4/5

Q 13   **Quality of the writing** — 4/5

Q 14   **Overall scientific quality of the study** — 4/5

REVISION LEVEL

Q 15   **Please make a recommendation based on your comments:**

Major revisions.