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# Willingness to Vaccinate against COVID-19 Might be Systematically Underestimated

## Abstract

Estimations of the willingness to vaccinate against COVID-19 are important to plan the vaccination process and also to coordinate efforts to reach herd immunity. **Aims and Objectives:** In this article, we test standard measures of vaccination willingness against systematic biases caused by misunderstandings and lack of information. We use a survey among 730 persons living in Germany at the start of the official vaccination program. We elicit willingness to vaccinate first in a standard form, and then again after clarifications and after providing additional information. We find that a substantial number of persons who state initially that they do not want to get vaccinated does so simply because they want to let people with higher risk be vaccinated first. Appropriately rephrasing the question increases the willingness by around 5 percentage points. Information about herd immunity increases the willingness by additional 7%, confirming previous findings. Standard survey-based estimates of vaccination willingness might underestimate the real number of persons who want to get a vaccination. This number can be increased even further by simply providing appropriate information on herd immunity. In our sample this increased vaccination willingness from 71.4% to 83.6%.

**Keywords:** COVID-19, herd immunity, vaccination, willingness to vaccinate

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## Introduction

To achieve herd immunity against COVID-19, a fairly large share of the population has to be immune which implies that a large proportion of the population needs to be vaccinated.<sup>[1]</sup> Willingness to get vaccinated are, however, not as high, as results from surveys in France,<sup>[2]</sup> Europe,<sup>[3]</sup> Australia,<sup>[4]</sup> and the U. S.<sup>[5]</sup> show. But will it really be as low? Or may misunderstandings or lack of basic information lead to (seemingly) low willingness for vaccinations that in reality will be larger?

In this article, we study this question which of course is important for policy decisions on vaccination campaigns as well as estimating the amount of vaccine needed.

## Methods

We conducted an online survey among 730 persons living in Germany on

December 21–28, 2020, just at the start of the official vaccination program in Germany, as part of a larger survey on COVID-19, previously documented in some studies.<sup>[6]</sup> The survey was advertised at several German universities, mostly using e-mail announcements (as part of regular university newsletters or separately) and e-mail invitations to participants of previous experiments. Given that most members of universities are students, they were a large group of the participants (82.7%), but the survey covered also nonstudents. About 54.4% of the participants were female. Participants were aged between 18 years and 99 years where the average age was 25.9 years. While the composition of the survey sample was not representative of the German population, it had enough variability to determine at least whether the results are dependent on age, gender, and education.

The survey was incentivized with a prize of 50€ for one randomly chosen participant. It was implemented in Enterprise Feedback Suite Questback (Unipark). The research protocol is approved by Ethics Committee

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**Table 1: Willingness to get vaccinated against COVID-19: initial responses, responses after clarification about the priority of risk groups, and responses after information on protective effects for others**

|  | <i>n</i> | No, definitely not (%) | Rather no (%) | Rather yes (%) | Yes, definitely (%) | Rather yes or definitely yes (total) (%) |
|--|----------|------------------------|---------------|----------------|---------------------|--|
| Willingness to get vaccinated (initial answer)                       | 730      | 10.8                   | 17.8          | 32.2           | 39.2                | 71.4                                     |
| Of those, who would rather or definitely not get a vaccination       |          |                        |               |                |                     | ( <i>t</i> =8.44***)                     |
| Willingness, after risk groups are vaccinated                        | 209      | 28.2                   | 54.1          | 17.2           | 0.5                 | 76.4                                     |
| Of those, who still would rather or definitely not get a vaccination |          |                        |               |                |                     | ( <i>t</i> =7.60***)                     |
| Willingness, after information regarding effects on risk patients    | 171      | 21.6                   | 48.0          | 28.1           | 2.3                 | 83.6                                     |

Numbers in parentheses show paired *t*-tests between the values above and below; both differences are significant on 0.1% level. \*\*\*Statistically significant with *P*<0.001

at Trier University according to §7.5 of the statutes of the ethic committee.

### Results

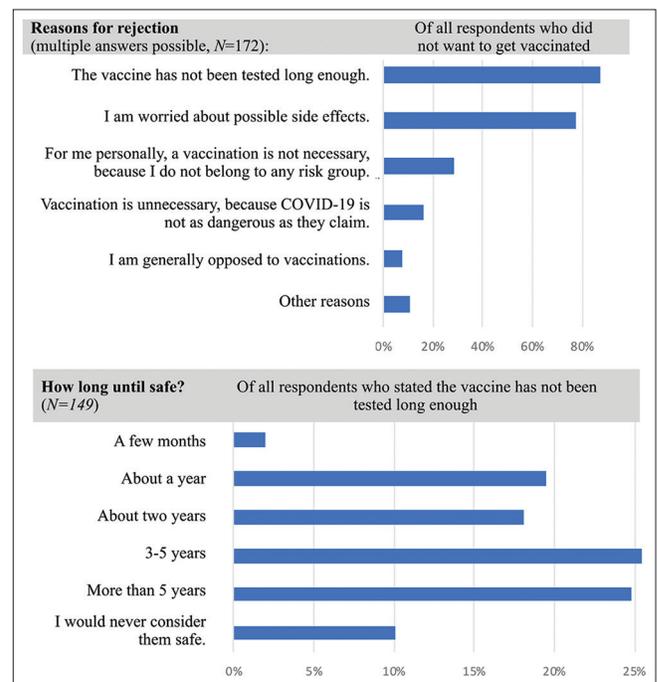
In the first key question, we asked participants: “If a vaccine against COVID-19 becomes available, would you get vaccinated? (Assuming that the cost is covered by health insurance).” (Potential answers were: Definitely yes, rather yes, rather no, definitely no). The results are shown in Table 1: 71.4% chose “rather yes” or “definitely yes.” We then asked those participants who had chosen “rather no” or “definitely no” the same question, but they added the following clarifying statement: “Let us now assume that all high-risk patients, medical staff, caregivers, etc., have already been vaccinated.” About 27.3% changed their mind. This suggests that the original question was misinterpreted by a substantial number of participants: A “no” to a question about vaccination might simply be an altruistic consideration. In our survey, the number of respondents choosing “rather yes” or “definitely yes” increased in this way by 5% to 76.4%.

We then presented to those still choosing “rather no” or “definitely no” the following text:

“Vaccinations do not work for everyone. For some people, e.g., the immune system does not respond enough to a vaccination. These people can then still get sick or even die. But if many people get vaccinated, they are unlikely to be infected by them. This provides an indirect protection. So, if you get vaccinated, you may save someone’s life! If you take that into account, would you get vaccinated?”

This text has been used in the previous research,<sup>[7]</sup> and this fairly simple intervention increased the total percentage of respondents choosing “rather yes” or “definitely yes” to 83.6%, similar to in previous experiments.<sup>[7,8]</sup> Both increases in vaccination willingness were statistically highly significant (*P* < 0.001).

We also elicited basic demographic information, in particular gender, age, and occupation. We converted the information on occupation into two dummy variables, one denoting whether a person was a university student (dummy variable *student*) and another one whether a person was either self-employed



**Figure 1: Stated reasons against a vaccination and time respondents would wait until considering the vaccination safe**

or employee (dummy variable working). As a proxy for education, we also elicited whether respondents had a university degree. We did not find significant effects of gender, age, student, working, and education on the final vaccination willingness [Figure 1]. These demographic factors do not lead to strong differences which suggest that our results likely also hold for the general population. Initial willingness to vaccinate, however, was slightly lower for females (*P* < 0.05).

In addition, we elicited potential reasons why people might not want a vaccination [Table 2]. The most frequently selected reasons were “The vaccine has not been tested long enough.” (Stated by 87.2% of those who did not want a vaccination 77.3%) and “I am worried about possible side effects.” Other reasons (not belonging to a risk group, belief in low harm of COVID-19, general opposition to vaccinations, and others) played a much smaller role.

We then asked those who worried about the too short test period when in future they would deem the vaccination to

**Table 2: Demographic characteristics and total willingness to obtain a COVID-19 vaccination (after survey treatment)**

|                                    | <i>n</i> | No, definitely not (%) | Rather no (%) | Rather yes (%) | Yes, definitely (%) | Rather yes or definitely yes (%) |
|------------------------------------|----------|------------------------|---------------|----------------|---------------------|----------------------------------|
| Total willingness at end of survey | 730      | 4.5                    | 11.9          | 43.7           | 39.9                | 83.6                             |
| Gender                             |          |                        |               |                |                     |                                  |
| Female                             | 300      | 6.0                    | 10.7          | 36.7           | 46.7                | 83.4                             |
| Male and others                    | 354      | 3.4                    | 15.0          | 46.0           | 35.6                | 81.6                             |
| Age (years)                        |          |                        |               |                |                     |                                  |
| 18-25                              | 597      | 3.9                    | 11.7          | 44.2           | 40.2                | 84.4                             |
| 26-40                              | 181      | 6.1                    | 13.3          | 44.8           | 35.9                | 80.7                             |
| 41-99                              | 36       | 5.6                    | 8.3           | 30.6           | 55.6                | 86.2                             |
| Profession                         |          |                        |               |                |                     |                                  |
| Student                            | 541      | 4.4                    | 13.5          | 41.2           | 40.9                | 82.1                             |
| Working                            | 94       | 3.2                    | 9.6           | 44.7           | 42.6                | 87.3                             |
| Education                          |          |                        |               |                |                     |                                  |
| No university degree               | 382      | 2.9                    | 13.6          | 43.7           | 39.8                | 83.5                             |
| University degree                  | 272      | 7.0                    | 12.1          | 39.0           | 41.9                | 80.9                             |

None of the differences between the demographic groups are statistically significant

be safe. The answers varied widely with a median value of around 3 years.

## Conclusion

In summary, the results give the reason for optimism: The number of people willing to get vaccinated might be higher than previous studies suggested. Indeed, a simple misunderstanding of the intent of standard formulations leads to an underreporting of around 5% for the percentage of people who definitely or probably want a vaccination.

Moreover, after providing information on indirect protecting effects of a vaccination through herd immunity, even more people were willing to get vaccinated. This shows that this (previously known<sup>[7,8]</sup>) effect is separate from the aforementioned increase. Both effects combined increased the willingness in our sample by more than 12 percentage points – a substantial amount. Given the insignificant dependence of our results on age, gender, and education, a quantitatively similar effect can be expected for the general population.

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## Conflicts of interest

There are no conflicts of interest.

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