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Forschungsbericht:

**Impact of Trust in Healthcare Professionals and Authorities on COVID-19 Vaccine Acceptance in Germany**

vorgelegt von

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# **Summary**

The article presented here was prepared in the form of a original research manuscript, which follows the manuscript formatting guidelines in the journal *Frontiers of Public Health*.

Supplementary material can be found in the appendix. The educational questionnaire, (see Appendix X), the questionnaire (see Appendix X) and a listing of places and platforms where the questionnaire was shared (see Appendix X). In addition, a case number calculation was done to estimate the number of cases needed (see Appendix X) and a directed acyclic grah (DAG) was created prior to data collection based on current literature (see Appendix X) to identify possible confounders.

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**Impact of Trust in Healthcare Professionals and Authorities on COVID-19 Vaccine Acceptance in Germany**

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**Keywords: COVID-19, SARS-CoV-2, Vaccine acceptance, Trust, HCPs**

# Abstract

**Introduction:** High acceptance of COVID-19 vaccines is instrumental to ending the pandemic(1, 2). This study aims to determine whether trust in healthcare professionals (HCPs) and authorities has an impact on vaccine uptake of the German public during the pandemic as well as to provide evidence that could possibly be used to ultimately remove obstacles preventing high vaccination coverage.

**Methods:** This study based on a cross-sectional online survey between August 1 and November 1, 2021 in Germany. Participants' demographic information, vaccination status and attitudes toward HCPs and institutions were focus analysed in this study. Descriptive analysis and logistic regression were used to detect the association of people`s attitudes toward HCPs and agencies (including government departments) with acceptance of COVID-19 vaccines.

**Results:** 88.9% of the participants showed an attitude of vaccine acceptance (received at least 1 vaccination or willness).High evaluation of doctors was associated with higher vaccine acceptance (aOR: 3.71, 95%CI: 1.39-10.14). The detailed explanation of vaccine information was associated with higher acceptance (aOR: 3.50, 95%CI: 1.79-7.02). High levels of satisfaction with government and official institutions were also associated with high levels of vaccine acceptance (aOR: 1.09, CI:1.08-1.12).

**Discussion:** High evaluation of doctor's treatment and detailed information on vaccines from the doctor were associated with high COVID-19 vaccine acceptance. High levels of satisfaction and trust in national and official institutions (including government) may be a particularly important factor in influencing people's willingness to be vaccinated. The number of male participants in this study was less than 1∕3 of the total number of participants, the difference between the number of male and female participants was too large to draw conclusions about the effect of gender on vaccine uptake. there was no association between high school diploma and previous vaccination history and covid-19 vaccine uptake. There was no significant evidence to suggest that socioeconomic factors influenced vaccine uptake in this study.

# Introduction

The current 2019 coronavirus pandemic (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) threatens and affects lives worldwide(3). In the context of the SARS-CoV-2 pandemic, vaccination is being discussed as essential in the effort to contain the incidence of infection (4). The status as of 09/28/2021 shows that nationwide 64% of the German population are fully vaccinated (5). To achieve an effective coverage of vaccination in Germany, at least 85% of the population aged 12 to 59 as well as 90% of the population aged 60 and older must be fully vaccinated against COVID-19 (6). Hence, there has been a growing interest in research surrounding the vaccination readiness in the population in connection with the SARS-CoV-2 pandemic. Currently, there is very little research on eradication strategies for acute infectious diseases which rely heavily on high vaccination levels for control, such as measles and COVID-19, and even less research on which factors can influence vaccination willingness in the general public (7-9). However, due to the recency of the topic, eg., vaccine readiness in the SARS-CoV-2 pandemic, only a limited number of studies refer to SARS-CoV-2 and the effects linked to the public’s commitment to vaccination (10, 11). Subsequently, it can be considered that factors influencing vaccination readiness may be transferable from other infectious diseases to SARS-CoV-2.

From existing literature, an individual’s perception, disease knowledge, and previous behavior appear to influence their participation in vaccination programs (12-14). Perceived susceptibility for a disease has been found to strongly influence participation in vaccinations (13, 15-18).

It has often been reported that the probability of declining a vaccination offer is increased if a person sees higher risk than reward in receiving the vaccination (19). When the perceived risk from the disease is low, the likelihood of participating in a vaccination program is lower (20). Furthermore, the commitment decreases when a great fear of unwanted side effects is present (21-23), and in general, higher anxiety levels are also associated with low vaccination frequency in the population (24). Additional barriers which limit the success of vaccination programs include the absence of professional vaccination recommendations (25), a lack of adequate transport options to vaccination clinics, and the financial burden it places on older people (26, 27).

Trust in the government and healthcare services significantly impact vaccination participation; more trust in the national government typically leads to a greater population vaccination willingness when compared to countries with less trust (28). The 5C model describes five key psychological reasons for vaccination participation (29). Four of the five C's from the 5C Model (confidence, complacency, constraints, and collective responsibility) appear to display an impact on vaccination participation (25), which will therefore require consideration when attempting to assess and optimize vaccination readiness. Only one of the five C’s (calculation) showed no impact on vaccination participation in previous studies (29). Overall, the attitude towards vaccination is probably the strongest predictor for the intention to vaccinate (30).

There is conflicting evidence regarding the impact of sociodemographic factors on vaccine readiness. In terms of gender, studies have shown that women could be more likely to get vaccinated than men of the same age (9). However, other studies have shown exactly the opposite and report that there is no clear link between gender and vaccination (31-33).

In terms of age, there is no definitive evidence showing which age group is more likely to get vaccinated (16, 31, 34-36). A study by Bock et al. shows that people who regularly get an influenza vaccination are one average three years older than the control group (8). Thus, it appears that age may influence vaccination participation for SARS-CoV-2 to some extent, though more information is needed to quantify this.

There are also several studies which deal with sociodemographic factors in which the results diverge strongly. Educational attainment, as with gender and age, appears to display conflicting evidence from literature as to its impact on vaccine readiness. Some studies show that people with high levels of education are more likely to be interested in vaccinations than people with low levels of education (17, 37). This contrasts a study from Myers et al., which showed the opposite (35).

Literature regarding previous illnesses appears to show discordant findings about an individual’s willingness to get vaccinated. Studies have shown that people with less diseases are more willing to get vaccinated than people who are in bad health conditions (17, 37). In contrary, other studies revealed that people who are willing to get vaccinated suffer more from chronic diseases than healthy people (8). Furthermore, it could be considered that people with unhealthy personal lifestyle choices (e.g., smoking, drugs etc.) show a lower willingness to get vaccinated (17, 37).

Knowledge about immunization is assumed to have both a positive and negative influence on an individual’s perception and attitude towards vaccination. A key factor which affects knowledge of immunization is how health information is researched. The modality of research appears to depend on the socioeconomic position of a person in addition to other personal characteristics, such as age and gender (38, 39).

The internet and social media play an increasingly important role in the dissemination of information about vaccinations and therefore could serve as a tool for spreading information about the vaccination (40) and thus have a presumed influence on vaccine acceptance or refusal (17, 41-43).

Furthermore, healthcare professionals (HCPs) are also thought to influence vaccination willingness (17, 41-43). Maurer et al. (44) and Schwarzinger et al. (31) describe that individuals who received information from a HCP were more likely to get vaccinated and in addition, vaccination willingness increased as a result of HCP recommendations.

It is often assumed that knowledge about herd immunity increases the likelihood of getting vaccinated (45). Similarly, a lack of information about herd immunity and vaccination could be one of the main reasons for low vaccination adherence (46). Overall, it can be assumed that there is a relationship between information-seeking behaviors as well as vaccination knowledge and vaccination willingness or refusal (46, 47).

Due to the recency of the SARS-CoV-2 pandemic, a very limited number of studies have covered factors that influence vaccination willingness or refusal during the SARS-CoV-2 pandemic (10, 11, 48). The initial results of nationwide COVID-19 vaccination readiness studies showed that the most relevant factors were the influence on confidence in the safety of vaccination and perception of personal and social benefits (10, 11, 48). These may be influenced by socioeconomic status and sociodemographic factors. For example, individuals with a low socioeconomic status have a lower tendency to get vaccinated. Furthermore, it was demonstrated that the media can influence the opinion of unvaccinated individuals in particular by creating uncertainty (10, 11, 48).

Vaccinations are one of the most effective agents when it comes to preventing the overburdening of the health care system as well as an increase in mortality as a result of severe COVID-19 cases (4). Moreover, it seems likely that detecting factors connected to vaccination willingness would be a distinct advantage for future health communication. On that account, this paper reports the results obtained from the online survey, in which people at the age of majority in Germany answered questions on specific topics that can be linked to the SARS-CoV-2 pandemic. This study was designed to evaluate factors associated with vaccination readiness and therefore to identify differences in vaccination willingness or refusal.

# Methods

## Study Design and Setting

This study shared baseline research data with a cross-sectional online survey named COVIM (Which Factors are Associated with a SARS-CoV-2 Vaccination Readiness in Germany?) from the University of Bremen. The COVIM survey was conducted in the German adult population between August 1 and November 1, 2021.

The questionnaire (Appendix X) of COVIM survey was estimated to take 15 min to complete, consisted mainly of multiple-choice questions, occasionally supplemented in some places with open text fields in order to provide space for extensive and individual answers. The questionnaire focused on participants' COVID-19 vaccination status and motivation, while also collecting information on participants' trust in and attitudes toward the German healthcare system, immigration background, socio-demographic characteristics (age, gender, education and employment status, income), daily information sources, political attitudes, current mental and physical health status, and general vaccination history (except COVID-19 vaccines).

The questionnaire design was informed by previous studies and a directed cyclic graph (Appendix X) creating to explore potential confounders. The questions were first pre-tested and were revised and finalized based on feedback from pre-testers.

The COVIM survey was published on commonly used social networks (Facebook, Telegram and WhatsApp etc.) as well as other public platforms. In addition, posters with a QR code were put up in frequently visited public places such as student residences, blood donation centers, or canteens to encourage participation in the survey. The following cites were considered: Berlin, Bielefeld, Bremen, Dresden, Frankfurt, Hannover, Hamburg.

## Study Variables

### Response variable

The response variable of interest in this study was the vaccination status of the study population against COVID-19, i.e. acceptance versus rejection. Participants who received the vaccine were defined as responders. Moreover, due to previous restrictions on vaccine access and vaccine supply in Germany, not all responders had received COVID-19 vaccination at the time of this research analysis, and some would-be vaccinated individuals were still on the waitlists or had not received vaccination appointments . Therefore, these participants were also defined as responders.

In the questionnaire, participants were asked to answer the following two questions: "Have you been vaccinated against coronavirus?" (Appendix X: Question 4/3) and "Would you like to be vaccinated against COVID-19?" (Appendix X: Question 4/9), possible responses were "Yes" or "No". Those who answered "yes" to either of the above two questions, i.e. respondents who received at least one vaccination or who were willing to be vaccinated, were defined as responders (acceptance).

### Sociodemographic characteristics

The following sociodemographic characteristics: age, gender, educational attainment, employment status, monthly income, household size, general vaccination history (Appendix X: Question 1/1, 2/1, 8/2, 8/3, 9/6, 9/5 and 2/4) were included in the analysisincluded.

Age was given in years. Educational attainment was divided into four categories: no occupational degree, occupational training, university degree (where university degrees include bachelor, master, national examinations, doctorate and above) and other. Employment status was divided into two groups (employed, unemployed). Individual monthly income was combined into four categories, <1.000 €, 1.000-2.000 €, 2.000-4.000 €, >4.000 €. Household size of respondents was divided into live alone and not live alone. Respondents who had received at least one dose of a protective vaccine (e.g., influenza, measles, etc.) were considered to have a past vaccination history. Respondents were also asked whether they were working as a healthcare worker (HCW) or not.

### Trust in HCPs

The level of trust in HCPs was assessed by the following three indicators: evaluation of the quality of doctor´s treantment (very high, rather high, rather low, very low), detailed explanation from doctor about the COVID-19 vaccines (yes, no), satisfaction with the doctor´s explanation about vaccines (very high, rather high, rather low, very low) (Appendix X: Question 5/4, 5/5 and 5/7).

### Satisfaction with authorities

Participants were asked about their satisfaction with the work of seven following German national and official agencies in the pandemic (Appendix X: Question 5/8): Federal Government, Federal Minister of Health (Jens Spahn), State Government, Health Department, Paul-Ehrlich-Institut, Robert-koch-Institut, German Vaccine Commission(STIKO). The answers of satisfaction were given in 5 categories: very satisfied, rather satisfied, can't say anything about this, rather dissatisfied and very dissatisfied. However, participants' satisfaction ratings with the seven agencies were converted into one variable in score. First, satisfaction (from high to low) with the seven agencies corresponds to scores of 50, 25, 0, -25, and -50, the mean score of the seven agencies for each participant would be considered as the satisfaction score with the national and offical agencies.

## Statistical Analysis

Data analyses were conducted using R version 4.1.2. Descriptive statistics were reported on socio-demographic characteristcs, reasons to get vaccinated, trust and attitudes towards HCPs, satisfaction scores of national and official agencies. P-values based on t-test for continuous variables and fisher-test for categorical variables were provided to detect differences between COVID-19 vaccination status groups (i.e., acceptance and rejection).

The logistic regression models were used to examine the association of participants’ attitude towards HCPs and satisfaction of national and official agencies with acceptance of COVID-19 vaccines. In the first step, effects of selected explanatory variables on vaccine acceptance were explored through univariate logistic regression. In the second step, all variables with p ≤0.05 in the first step were selected for modeling using multivariate logistic regression (denoted as Full Model) to deal with a large number of covariates and confounding factors simultaneously. In the third step, adjusted multivariate logistic regression was performed using Akaike Information Criterion (AIC) based stepwise logistic regression to explore better model.

Furthermore, to detect the effect of missing values, a sensitivity analysis was performed using multiple imputation based on predicted mean matching (PMM), which is applicable to both continuous and categorical variables.

## Ethical Approval

The COVIM survey was conducted as part of a student research project. Thus, there is no opportunity to obtain an ethics vote for the survey and to publish the obtained results. All participants’ data were collected anonymously. This means that they cannot be re-identified. Participants were informed about data protection guidelines and the disclosure of their data before participating in the study. Participant data were stored in a password-protected manner during the study so that only the researchers have access to the data. Due to anonymizing the personal data, subsequent deletion is no longer possible. In addition to the General Data Protection Regulation (GDPR), general human rights and the Charter of fundamental rights of the European Union were also respected when handling the data. To verify the age of the majority, the age of the participants was also requested at the beginning of the questionnaire.

# Results

## Descriptive statistics results

### Disposition and vaccination status

We received 1,131 responses during the COVIM survey period, 303 of them were excluded due to incomplete data (i.e., finishing less than half of the survey). 5 responses of the 828 completed questionnaires were missing vaccine status information, therefore the final sample size of the current study was 823 (Figure 1). The majority of these participants were defined as Vaccine Acceptance (N = 732/823, 88.9%, of which 710 participants received at least one dose of COVID-19 vaccine and 22 intended to be vaccinated), 91 participants (11.1%) was defined as Vaccine Rejection.

Diagram

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Figure 1: Data selection procedure

The information on vaccination doses does not include booster doses because at the time of the survey, two doses of vaccination were considered complete immunisation in Germany. As shown in Table 1, more than 80% participants were fully immunised and more than half received BioNTech (Appendix A). Protection of family members and themselves, the desire to return to normal life and to contribute to society are the most common reasons for vaccination (Table 1).

Table 1: COVID-19 vaccination status (N=732)

|  |  |  |
| --- | --- | --- |
|  | n | % |
| **Vaccine acceptance distribution** |  |  |
| At least 1 vaccination | 710 | 86.3 |
| *Dose of vaccination:* |  |  |
| *1 dose* | *64* | *8.7* |
| *1 dose (Johhnson&Johhnson)* | *38* | *5.2* |
| *1 dose (I am recovered)* | *12* | *1.6* |
| *2 doses* | *596* | *81.4* |
| willingness to be vaccinated | 22 | 2.7 |
| **Reasons to get vaccinated** |  |  |
| Occupational reasons | 355 | 43.1 |
| Reduce the risk of infection | 692 | 84.0 |
| Return to normal life | 671 | 81.5 |
| Protecting your family | 690 | 83.8 |
| Driven by social environment | 234 | 28.4 |
| social contribution | 675 | 82.0 |
| Relieving pressure on the healthcare system | 646 | 78.4 |

### Sociodemographic Characteristics

As displayed in Table 2, the average age of the participants with vaccine acceptance was lower (28.7 ± 10.8) and was 7 years younger than the rejection group (35.7 ± 14.8). Most participants were females (72.1% vaccine acceptors and 70.3% rejectors). Over 90% vaccine acceptors have a high school diploma. According to ISCED 2011 standards 50% of the participants have received high education. Around 1/3 participants worked in health-related industries and 1/5 of them live alone. Only a small proportion have no vaccination history and the vast majority have received at least one dose of protective vaccine. Histogram for age and bar charts of sociodemographic variables are shown in figure 2.

Table 2: Demographic analyses between COVID-19 vaccine acceptance and rejection group

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Demographic variables** | **Vaccine Acceptance**  **N=732** | | **Vaccine Rejection**  **N=91** | | **p-value** |
| **n** | **%** | **n** | **%** |
| **Age (in years)** |  |  |  |  | **<0.05** |
| Mean (SD) | 28.7 (10.8) | | 35.7 (14.8) | |  |
| Median | 25 | | 30 | |  |
| Q1, Q3 | 22, 30 | | 24, 45 | |  |
| Min, Max | 18, 73 | | 18, 99 | |  |
| **Gender a** |  |  |  |  | 0.117 |
| Female | 528 | 72.1 | 64 | 70.3 |  |
| Male | 197 | 26.9 | 23 | 25.3 |  |
| **High school diplomab** |  |  |  |  | <0.05 |
| yes | 678 | 92.6 | 71 | 78.0 |  |
| no | 51 | 7.0 | 19 | 20.9 |  |
| **Educational attainmentc** |  |  |  |  | <0.05 |
| No occupational degree | 218 | 29.8 | 10 | 11.0 |  |
| Occupational training | 125 | 17.1 | 34 | 37.4 |  |
| University degree | 371 | 50.7 | 46 | 50.5 |  |
| **Employment status** |  |  |  |  | 0.532 |
| Employed | 675 | 92.2 | 86 | 94.5 |  |
| Unemployed | 57 | 7.8 | 5 | 5.5 |  |
| **Healthcare related job** |  |  |  |  | 0.902 |
| Yes | 210 | 28.7 | 25 | 27.5 |  |
| no | 522 | 71.3 | 66 | 72.5 |  |
| **Monthly income (in €)d** |  |  |  |  |  |
| <1.000 | 378 | 51.6 | 27 | 29.7 |  |
| 1.000-2.000 | 176 | 24.0 | 29 | 31.9 |  |
| 2.000-4.000 | 127 | 17.3 | 20 | 22.0 |  |
| >4.000 | 26 | 3.6 | 10 | 11.0 |  |
| **Household sizee** |  |  |  |  | 0.482 |
| Live alone | 147 | 20.1 | 20 | 22.0 |  |
| Not live alone | 573 | 78.3 | 65 | 71.4 |  |
| **Vaccination historyf** |  |  |  |  | <0.05 |
| yes | 636 | 86.9 | 71 | 78.0 |  |
| no | 95 | 13.0 | 20 | 22.0 |  |

a For gender, divers in acceptance=6, rejection=3 were not provided in Table 2.  
b missing in acceptance=3, rejection=1 were not provided in Table 2.  
c missing and others in acceptance=18, rejection=4. d missing in acceptance=25, rejection=5. e missing in acceptance=12, rejection=6. f missing in acceptance=1.

Timeline

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Figure 2: Histogram of the distribution of vaccine acceptance and rejection among socio-demographic characteristics

### Trust in HCPs and Satisfaction with authorities

Only a small number of participants (95/823, 11.5%) rated the quality of the doctor's treatment as rather/very low, with the vast majority rating the doctor very highly. Two thirds (532/823, 64.6%) reported receiving a detailed explanation from their doctor about the vaccine, and the majority (488/823, 59.3%) were satisfied with the doctor's explanation. In terms of institutions satisfaction scores, the acceptance group was positive while the refusal group was negative, and the mean score of the satisfaction scores was significantly higher in the acceptance group than in the rrejection group(Table 3). Histogram of trust variables are shown in figure 3. We can clearly see the differences between the groups.

Table 3: Trust level between COVID-19 vaccine acceptance and rejection group

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Vaccine Acceptance**  **N=732** | | **Vaccine Rejection**  **N=91** | | **p-value** |
|  | **n** | **%** | **n** | **%** |
| **Evaluation of the quality of doctor´s treantmenta** |  |  |  |  | <0.05 |
| Very high | 270 | 36.9 | 21 | 23.1 |  |
| Rather high | 388 | 53.0 | 37 | 40.7 |  |
| Rather/Very low | 65 | 8.9 | 30 | 33.0 |  |
| **Did the doctor give a detailed explanation about the corona vaccineb** |  |  |  |  | <0.05 |
| Yes | 507 | 69.3 | 25 | 27.5 |  |
| no | 221 | 30.2 | 62 | 68.1 |  |
| **Satisfaction with the doctor´s explanation about vaccinec** |  |  |  |  | <0.05 |
| Very high | 277 | 37.8 | 5 | 5.5 |  |
| Rather high | 200 | 27.3 | 6 | 6.6 |  |
| Rather/Very low | 29 | 3.9 | 13 | 14.3 |  |
| **Satisfaction scores of agencies** |  |  |  |  | <0.05 |
| Mean (SD) | 7.6 (16.9) | | -27.1 (20.0) | |  |
| Median | 7.1 | | -32.1 | |  |
| Q1, Q3 | -3.6, 19.6 | | -42.9, -14.3 | |  |
| Min, Max | -50, 50 | | -50, 25 | |  |

a missing in acceptance=9, rejection=3.  
b missing in acceptance=4, rejection=4.   
c missing in acceptance=226, rejection=67.

Chart, bar chart

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Figure 3: Histogram of the distribution of vaccine acceptance and rejection among trust in HCPs and authorities

## Acceptance of COVID-19 Vaccine and Associated Variables

The univariate logistic regression was first used to screen for the effects of a single variable. Gender, employment status, health care-related job and household size were not included in the full model due to insignificant effects (p ≥ 0.05). Moreover, since the variable *satisfaction with the doctor explanation about vaccine* is a subquestion of variable „*detailed explanation from doctor about Corona vaccine”* (perfectly collinear), only variable „*detailed explanation from doctor about Corona vaccine” was* include in the full model.

Table 4: Univariable logistic regression

|  |  |  |  |
| --- | --- | --- | --- |
| **Predictors** | **Odds Ratios** | **95%CI** | **p-value** |
| **Age (in years)** | 0.96 | 0.95 – 0.98 | **<0.001** |
| **Gender** |  |  |  |
| Male | 1.00 | Reference |  |
| Female | 0.96 | 0.57 – 1.57 | 0.884 |
| **High school diploma** |  |  |  |
| No | 1.00 | Reference |  |
| Yes | 3.56 | 1.95 – 6.27 | **<0.001** |
| **Educational attainment** |  |  |  |
| No occupational degree | 1.00 | Reference |  |
| Occupational training | 0.17 | 0.08 – 0.34 | **<0.001** |
| University degree | 0.40 | 0.18 – 0.77 | **0.010** |
| **Employment status** |  |  |  |
| No | 1.00 | Reference |  |
| Yes | 1.45 | 0.62 – 4.25 | 0.437 |
| **Healthcare related job** |  |  |  |
| No | 1.00 | Reference |  |
| Yes | 1.06 | 0.66 – 1.76 | 0.809 |
| **Monthly income (in €)** |  |  |  |
| <1.000 | 1.00 | Reference |  |
| 1.000-2.000 | 0.43 | 0.25 – 0.75 | **0.003** |
| 2.000-4.000 | 0.45 | 0.25 – 0.85 | **0.011** |
| >4.000 | 0.19 | 0.08 – 0.44 | **<0.001** |
| **Household size** |  |  |  |
| Live alone | 1.00 | Reference |  |
| Not live alone | 1.20 | 0.69 – 2.01 | 0.504 |
| **Vaccination history** |  |  |  |
| No | 1.00 | Reference |  |
| Yes | 1.89 | 1.07 – 3.19 | **0.022** |
| **Evaluation of the quality of doctor´s treatments** |  |  |  |
| Very/rather low | 1.00 | Reference |  |
| Rather high | 4.84 | 2.79 – 8.38 | **<0.001** |
| Very high | 5.93 | 3.21 – 11.16 | **<0.001** |
| **detailed explanation from doctor about Corona vaccine** |  |  |  |
| No | 1.00 | Reference |  |
| Yes | 5.69 | 3.53 – 9.44 | **<0.001** |
| **Satisfaction with the doctor explanation about vaccine** |  |  |  |
| Very/rather low | 1.00 | Reference |  |
| Rather high | 14.94 | 5.47 – 45.47 | **<0.001** |
| Very high | 24.83 | 8.71 – 82.07 | **<0.001** |
| **Satisfaction scores of national and official agencies** | 1.10 | 1.08 – 1.12 | **<0.001** |

As mentioned above, the following variables were selected for multivariate logistic regression to build the full model: XX, XX, XX, … , XX. Moreover, adjusted multivariate logistic regression was explored using three different approaches in data analysis: AIC based stepwise logistic regression, AIC based best subset selection and penalized regression using elastic net regularization based on 5-fold cross validation. The results of the model comparison are showed in Appendix B and AIC, BIC, Tjur R2 were used for model evaluation. The AIC based stepwise logistic regression had best performance with largest Tjur R2 and smallest AIC, BIC. Results of multivariate logistic regression from Fulll Model and adjusted model are shown in Table 5.

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## Sensitivity analysis

Table 6: Results of sensitivity analysis

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| --- | --- | --- | --- | --- | --- | --- |
| **Predictors** | **Full Model** | | | **sensitivity analysis** | | |
| **OR** | **95%CI** | **p-value** | **OR** | **95%CI** | **p-value** |
| **Age (in years)** | 0.98 | 0.95 – 1.01 | 0.128 | 0.97 | 0.95 – 1.00 | 0.073 |
| **High school diploma** |  |  |  |  |  |  |
| No | 1.00 | Reference |  | 1.00 | Reference |  |
| Yes | 0.77 | 0.24 – 2.40 | 0.659 | 0.57 | 0.19-1.68 | 0.315 |
| **Educational attainment** |  |  |  |  |  |  |
| No occupational degree | 1.00 | Reference |  | 1.00 | Reference |  |
| Occupational training | 0.33 | 0.10 – 1.01 | 0.056 | 0.30 | 0.10 – 0.83 | **0.023** |
| University degree | 0.68 | 0.23 – 1.86 | 0.465 | 0.80 | 0.29 – 2.07 | 0.647 |
| **Monthly income (in €)** |  |  |  |  |  |  |
| <1.000 | 1.00 | Reference |  | 1.00 | Reference |  |
| 1.000-2.000 | 0.42 | 0.17 – 0.99 | **0.048** | 0.46 | 0.20-1.04 | 0.061 |
| 2.000-4.000 | 0.77 | 0.30 – 2.00 | 0.583 | 0.74 | 0.31-1.81 | 0.509 |
| >4.000 | 0.47 | 0.12 – 1.89 | 0.276 | 0.40 | 0.11-1.47 | 0.159 |
| **Vaccination history** |  |  |  |  |  |  |
| No | 1.00 | Reference |  | 1.00 | Reference |  |
| Yes | 1.70 | 0.68 – 4.09 | 0.245 | 1.91 | 0.83-4.25 | 0.118 |
| **Evaluation of the quality of doctor´s treatments** |  |  |  |  |  |  |
| Very/rather low | 1.00 | Reference |  | 1.00 | Reference |  |
| Rather high | 2.50 | 1.03 – 5.95 | **0.040** | 2.50 | 1.10 – 5.60 | **0.027** |
| Very high | 2.49 | 0.90 – 6.90 | 0.078 | 2.28 | 0.89-5.85 | 0.084 |
| **detailed explanation from doctor about Corona vaccine** |  |  |  |  |  |  |
| No | 1.00 | Reference |  | 1.00 | Reference |  |
| Yes | 3.96 | 2.01 – 8.04 | **<0.001** | 3.19 | 1.68 – 6.16 | **<0.001** |
| **Satisfaction scores of agencies** | 1.10 | 1.08 – 1.12 | **<0.001** | 1.09 | 1.08 – 1.12 | **<0.001** |



# Discussion

In this study, high evaluation of doctor's treatment and detailed information on vaccines from the doctor were associated with high COVID-19 vaccines acceptance. The observed association are consistent with many previous vaccine studies, a high level of trust and compliance in HCPs can play a key role in promoting patients' vaccine decision-making process.

Outreach strategies by general practitioner and specialist are critical to building trust in COVID-19 vaccination. These strategies can include communications sent to patients and time allocated during office visits to discuss COVID-19 vaccination. This is important not only for the current COVID-19 vaccination, but also for booster vaccinations.

However, it is not enough for HCPs to act as vaccination messengers; current research also shows that high levels of satisfaction and trust in various official institutions, including government, may be a particularly important factor in influencing people's willingness to be vaccinated. Federal and local governments and health system leaders should therefore work to develop messaging strategies to effectively combat vaccine hesitancy. In addition, local health care providers, mass media and political leaders play an important role in increasing confidence in COVID-19 vaccination. Local vaccine program directors should consider collaborating with multiple partners to develop strong communication and promotion activities on a range of vaccination messages.

The current study lacked detailed specific information on the socio-demographic and socio-economic characteristics of population. Evidence from previous studies on the effect of age and gender on vaccine uptake is equivocal, and the current study has only slight evidence to suggest that older age groups are more likely to be vaccine hesitant. Because our sample population was young, with an average age of 29 years for the total sample, there was a serious lack of older samples. Although marginally significant results were obtained, they are not sufficient to suggest that there is an association between age and vaccine intention.

The number of male participants in this study was less than one third of the total number of participants, the difference between the number of male and female participants was too large to draw conclusions about the effect of gender on vaccine uptake.

With the exception of the age factor, there was no association between high school diploma and previous vaccine history and COVID-19 vaccine uptake. As most of the actual participants in this study were students, nearly 90% of the respondents had taken the Abitur exam, the sample lacked generalisability, there was a lack of variation in socio-economic characteristics, and half of the respondents reported having a university degree or higher.

These socio-demographic and socio-economic characteristics measured in this study are therefore not really representative of the German population in general, and there is a significant lack of information on the occupational training population and industry. In order to determine the relevant factors, studies with more heterogeneous populations may be needed.

## Bias

Due to the online recruitment, a selection bias could not be avoided. Therefore, people with an affinity for media or the topic of the study and those with easier internet access were more likely to participate (repeatedly) in the survey. In addition, due to self-selection, volunteers are more motivated than randomly selected individuals, and therefore volunteer bias should be taken into account. Thus, the data represent only a subset of the population, and are therefore not generalizable to the general population.

## Limitation

This cross-sectional study represents a snapshot at the time of the survey, within a short survey period. However, the Covid-19 pandemic is a dynamic event, vaccination readiness changes, as do infection incidence, risk assessment, and other attitudes in the context of the Covid-19 pandemic. The survey reported in the present study shows the status before the start of the fifth Sars-CoV-2 wave (omicron), where the delta variant was the dominating Sars-CoV-2 variant. Comparability with current research is limited because factors related to the context mentioned above may have changed or new ones may have been added. Consequently, the results of other studies could differ, and comparability is difficult. In addition, the sample size of approximately 897 respondents allows and subgroup analyses are not possible due to limited representativeness and sample size. Furthermore, the cross-sectional observational data in this study does not allow for causal inference or determination of timing and associations between different variables.

According to the selection bias described above the study population in the present study is not a representative sample reflecting the general German population. Less than one third of the recruited persons were male participants, therefore no conclusions about the influence of gender on the readiness to be vaccinated can be drawn. 38% of the participants were students, more than 90% indicated to have a high school diploma (A-Levels / Abitur) and over 80% of the sample fell into the young age categories (18-25 y, 26-35 y). Hence, the measured sociodemographic characteristics are not representative of the general German population. A more heterogeneous sample is necessary to determine representative factors that influence vaccination attitudes valid for the general population. In addition, the proportion of those participants vaccinated at least once is higher than the proportion of unvaccinated participants. Therefore the sample from the COVIM-Study could be thinking more positively about vaccinations than the general German population. Thus the proportion of those willing to be vaccinated could be overestimated and thus the achievable vaccination rate, could be overestimated.

# **Conclusion**

Acceptance of the COVID-19 vaccine in Indonesia is influenced by the effectiveness of the vaccine. Acceptance is relatively high when the vaccine has a very high effectiveness, but it reduced to only 67.0% when the vaccine efficacy is 50%. If the COVID-19 vaccine has lower efficacy, governments will have to introduce more strategies to persuade their population to become vaccinated. In addition, since acceptance is associated with perceived risk for COVID-19, it is also important to increase the perceived risk in communities.

# **Conflict of Interest**

The author declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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# **Appendix**

Appendix A: Vaccination status by manufacturer

|  |  |  |
| --- | --- | --- |
| Vaccine brands | n (N=823) | % |
| **First dose** |  |  |
| AstraZeneca | 95 | 11.5 |
| BioNTech/Pfizer | 474 | 57.6 |
| Moderna | 102 | 12.4 |
|  |  |  |
| **Second dose** |  |  |
| AstraZeneca | 17 | 2 |
| BioNTech/Pfizer | 469 | 57 |
| Moderna | 110 | 13.4 |

Appendix B: model comparison