

Comparison of SARS-CoV-2 Vaccination Skepticism, Reasons, and Concerns Between Mass Vaccination Centers and General Practices in Germany 2021

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Introduction: The reluctance to be vaccinated against COVID-19 has significantly curbed vaccine uptake. Unlike mass vaccination centers, general practitioners (GPs) might be able to address some of the patients' concerns through their long-term doctor-patient relationship. This study compared vaccination reasons, concerns and skepticism about vaccination, and perceived importance of the vaccine and its hypothetical value between vaccination centers and GP practices.

Methods: A survey was distributed (07/2021-10/2021) among newly vaccinated individuals in ten GP practices (n = 364) and two vaccine centers (n = 474).

Results: Participants in vaccine centers stated more prosocial and benefit-oriented reasons for vaccination, whereas participants in GP practices more often stated the GP's recommendation as the reason. Perceived importance of the vaccine in combating the pandemic was rated higher among individuals at vaccine centers and with higher health awareness and self-efficacy. Participants at both types of sites who preferred a GP for vaccination expressed more vaccination skepticism, which was also related to older age, more health risk concerns related to COVID-19 vaccines, and lower perceived importance of the vaccine.

Conclusion: Our results indicate opportunities for framing future vaccination campaigns that include vaccination centers. Additionally, a rapid GP involvement in future mass vaccinations might be crucial for overcoming attitudinal barriers and achieving higher vaccine uptake.

Keywords: COVID-19, vaccines, immunization programs, mass vaccination, vaccination hesitancy, attitude to health

Introduction

After an accelerated authorization procedure, the first SARS-CoV-2 vaccine was approved in December 2020 in the European Union, followed by two more in January 2021.¹ At the beginning of the European COVID-19 vaccination campaign, vaccines were administered according to prioritization groups, such as age, occupation, and co-morbidities, due to initial shortages in vaccine doses and logistical challenges.^{2,3} In Germany, mass vaccination centers were implemented starting in December 2020 to manage the initial high vaccine demands and were joined by general practitioners (GPs) across Germany in April 2021.⁴ GPs received a limited portion of the vaccine doses to vaccinate their patients in their community-based practices and also had to adhere to the allocation according to prioritization groups. The prioritization groups were suspended in June 2021, however, vaccine uptake stagnated considerably, which has been discussed as a result of an emerging vaccination hesitancy.^{5,6} The German government intended to vaccinate 85% of the population under 60 years of age and 90% of the population over 60 years of age against COVID-19 to reach herd immunity.⁷ These targets have never been achieved, despite evidence that COVID-19 vaccinations reduced total global deaths by 63% in the first year of vaccination⁸ and showed protective properties against subsequent variants of the virus.⁹ At the time of the present study, less than half of the German population had been vaccinated.⁵

The reluctance to get a vaccination in general and against COVID-19 specifically has been found to have multiple and complex reasons. With respect to COVID-19, socio-demographic factors, such as female gender or younger age,^{10–14} were strong predictors for reduced vaccine uptake. Education, however, showed mixed interactions.¹⁴ Further, vaccine types gained differing levels of trust, with the mRNA vaccines receiving higher levels compared to the vector vaccine, potentially influenced by the varying immunological efficacy, safety concerns, and media coverage.¹⁵ Other factors such as attitudes and beliefs have also been identified to be associated with vaccination hesitancy, particularly vaccination skepticism, social pressure, perceived vaccine safety, skepticism due to rapid clinical approval procedures, past vaccination refusal, healthcare system and authority distrust, media usage, and political affiliation.^{6,14,16–20} Some of these concerns were based on safety reports of rare but serious adverse events caused by COVID-19 vaccines, such as myopericarditis or thrombosis. While myopericarditis did not occur more frequently than after other types of vaccination,²¹ the risk for thrombosis was higher after COVID-19 vaccines compared to influenza.²² Minor systemic reactions, such as chills or headache, were also more common after COVID-19 vaccinations compared to influenza,^{23,24} indicating at least partly justified concerns.

In contrast to other medical specializations, GPs might be able to overcome some of the above-mentioned concerns in patients treated previously by using the trust gained in their long-term doctor-patient relationship.^{25–28} Particularly, the length of the relationship might enhance trust in the health care provider²⁹ and trust in the provider has been found to be a factor influencing the willingness to get vaccinated.³⁰ The underlying mechanism might be effective patient-centered communication strategies,^{31–33} especially regarding vaccine safety and necessity.³⁴ For example, it has been shown that the provision of a verbal health education for influenza vaccinations substantially increased the vaccine uptake especially in individuals whose initial vaccination intention was uncertain.³⁵ Further, repeated exposure to information about vaccination benefits might increase vaccine uptake,³⁶ indicating that GPs might be especially able to target vaccine hesitant individuals through their repeated face-to-face meetings. In contrast, mass vaccination centers might be less suited to attract vaccination hesitant individuals.^{27,37–39}

For future vaccination campaigns and to increase SARS-CoV-2 vaccine uptake, it is important to understand which vaccine sites are best suited to address factors such as attitudes and motivations. To our knowledge, no study directly investigated if previous COVID-19 vaccination hesitancy varied between individuals receiving their vaccine in a GP practice and those receiving their vaccine in a mass vaccination center. This study was conducted more than six months following the initial SARS-CoV-2 vaccine approval in Germany in mid-2021. During this period, prioritization groups had already been suspended, and the incidence of COVID-19 cases was relatively low, enabling widespread access to vaccination. Consequently, the demographics of the vaccinated population shifted towards a younger, less comorbid, and non-high-risk group. Moreover, this particular time period offered a unique opportunity for comparing the motivation for vaccination across different vaccination sites, as vaccination centers were subsequently closed. By distributing a paper-based survey among newly vaccinated individuals in both types of vaccine sites, this study aimed to examine participants' reasons for vaccination, their concerns regarding the vaccination, perceived importance, and potential differences between sites. In addition, participants' hypothetical willingness to pay for the vaccination, used as an indicator for the value attributed to the vaccine, was assessed and compared between sites. We also examined whether vaccination skepticism and concerns differed in participants who preferred a particular vaccine site, regardless of where they received the vaccine. Finally, sociodemographic characteristics were considered in all analyses to identify population groups that were more likely to express concerns or certain attitudes.

Methods

Procedure

The data were collected between July 2021 and October 2021 in the Free State of Saxony, Germany by using a cross-sectional questionnaire study design. We calculated a required sample size for surveys of at least 601 completed questionnaires based on the overall population in Saxony (4,043,002 in 2021), a percentage of occurrence of 50%, confidence level of 95%, and a 4% margin of error. Vaccination centers and GP practices in both city and rural areas of Saxony were invited on a convenience basis to voluntarily participate in the study and distribute a self-developed

questionnaire among vaccinated individuals over 18 years of age who had received their first or second SARS-CoV-2 vaccine. Participants completed the survey immediately after receiving their vaccine within their recommended 15 min observation time.

In total, we recruited two vaccine centers and ten GP practices. The two vaccination centers received in total $n = 650$ questionnaires to distribute: $n = 350$ in Leipzig-Messe (city area) and $n = 300$ in Belgern (rural area). Ten GP practices received in total $n = 450$ questionnaires, of which five GP practices were located in the city area of Leipzig ($n = 195$ questionnaires) and five practices were located in a rural area, Leipziger Land/Nordsachsen ($n = 255$ questionnaires). A part of this study was reported elsewhere with the same sample and procedure.⁴⁰ The recruitment process is depicted in Figure 1.

Questionnaire

The patient questionnaire was self-developed in the Institute for General Practice of the Leipzig University by an interdisciplinary research team (medical scientists and GPs) in a multi-stage revision process. In addition, an extensive literature search aimed at identifying relevant factors for the reasons for receiving vaccines and potential concerns complemented the questionnaire development.^{18–20,25,29,30} The questionnaire was adjusted for the respective vaccination site and varied in terms of wording. It contained the following topics: 1) socio-demographics (eg, age, gender, education, occupation, influenza vaccine status), 2) reasons for obtaining vaccination, and 3) attitudes towards and perceived importance of SARS-CoV-2 vaccinations and vaccine site preference.

Education was assessed by using the CASMIN educational classification.⁴¹ Attitudes were assessed by means of either 5-point or 10-point rating scales. Participants were asked on a 5-point scale if they agreed or disagreed with a given statement (eg, “I am generally skeptical about COVID-19 vaccines”, 1 = Strongly disagree, 5 = Strongly agree). Item-specific response options were given on 10-point rating scales (eg, “How important was it for you to be vaccinated against COVID-19 as soon as possible?”, 1 = Not at all important, 10 = Very important). All survey questions were assigned abbreviated labels. For instance, the term “vaccination skepticism”, as employed in the analyses, corresponds to the survey question “I am generally skeptical about COVID-19 vaccines”. All items analyzed in this study and their abbreviated labels can be found in the results section.

The questionnaire underwent a think-aloud pre-testing⁴² aimed at identifying problems or misunderstandings related to each item. The provisional questionnaire was filled out by five patients from the targeted group who were instructed to think aloud while answering each item and report every spontaneous thought. All patients were subsequently interviewed, leading to additional revisions and simplifications of some items. These five pre-testing questionnaires were not included in the final sample. The final version of the questionnaires can be found in [Supplementary Material S1a, b](#).

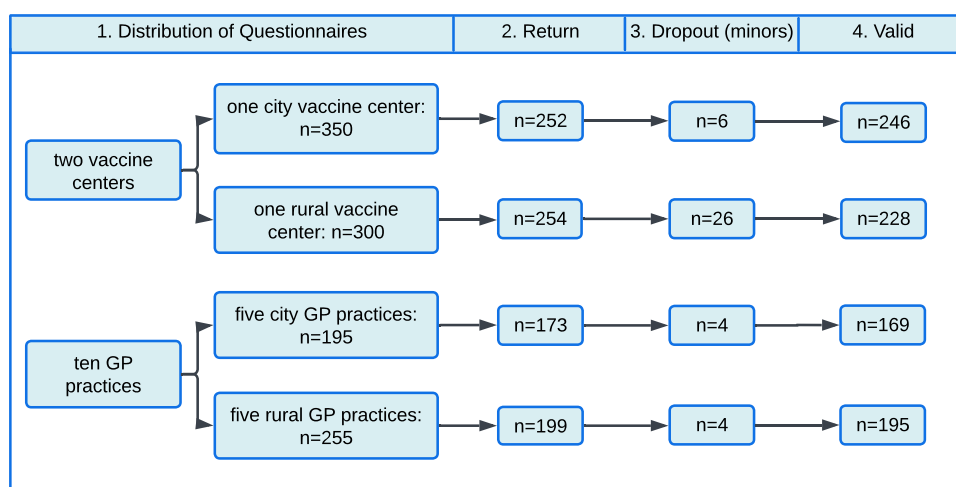


Figure 1 Flowchart of recruitment process.

Ethics Statement

The study was carried out in accordance with the Declaration of Helsinki and the study protocol was approved by the research ethics committee of the Leipzig University (reference number 314/21-ek). Participants agreed to participate by voluntarily returning the anonymous questionnaire. No personal data besides age and sex were assessed.

Statistical Analyses

All statistical analyses were carried out using IBM SPSS Statistics 27 (Armonk, NY, USA) with a two-sided α -level of 0.05. For descriptive statistics, missing values in single variables were considered by presenting frequencies as % (n/n_{valid}). Continuous variables were presented as mean \pm standard deviation (SD). Differences between groups (“vaccine center city”, “vaccine center rural”, “GP practices city”, “GP practices rural”) were analyzed with the following tests: Group differences in categorical variables were analyzed using chi-square or Fisher’s exact tests. Estimated effect sizes were reported using Cramer’s V. Group differences in non-normally distributed continuous variables (age and rating scales) were analyzed using Kruskal-Wallis tests and subsequent post-hoc tests with Bonferroni corrections. Estimated effect sizes are reported using Cohen’s d . Two-sided bivariate correlations were calculated to analyze the association of attitudes towards vaccination with vaccine site preference.

Further, multiple linear regression analyses using Entry method were conducted. 1) The predictive ability of demographic variables, reasons for vaccination, health risk concerns, perceived importance of the vaccine, and perceived own influence on the infection risk (independent variables) in explaining vaccination skepticism (dependent variable) was calculated. 2) The predictive ability of demographic variables, reasons for vaccination, health risk concerns, and perceived own influence on the infection risk (independent variables) in explaining the perceived importance of vaccination for combating the pandemic (dependent variable) was calculated. Lastly, a multiple logistic regression analysis using Entry method was conducted to calculate 3) the predictive ability of demographic variables, reasons for vaccination, vaccination skepticism, health risk concerns, and perceived importance of the vaccine (independent variables) in explaining the willingness to pay for vaccination (dependent variable, only “yes” and “no” were included, participants answering “not sure” were excluded from analysis). For all models, assumption checks for multiple linear or logistic regressions were performed before interpretation. Results of these checks can be found in [supplementary material S2](#).

Results

Sample Characteristics

In total, 1100 questionnaires were distributed in two vaccine centers and ten GP practices (see [Figure 1](#)), of which 838 were filled out and were eligible for analyses (response rate of 76.2%). Percentages, means, and standard deviations for sample characteristics can be found in [Table 1](#) and in Jentzsch et al 2022.⁴⁰

Participants’ Reasons, Concerns, and Willingness to Get the SARS-CoV-2 Vaccine

We examined participants’ reasons for getting vaccinated, concerns regarding the vaccination, perceived importance of getting vaccinated, and willingness to pay for the vaccination (WTP, as an indicator for the value attributed to the vaccine). Percentages and differences between vaccination sites can be found in [Table 2](#). Whereas benefits through the vaccination and protection of others were more likely reasons for vaccinations in individuals in vaccine centers, individuals in GP practices were more likely to state that their GP’s recommendation was a reason for vaccination. Participants in GP practices reported being slightly more skeptical towards the vaccine compared to participants in vaccine centers ([Figure 2](#)). Being vaccinated as soon as possible was more important to participants in rural GP practices compared to the other sites. In addition, participants in vaccine centers, especially in the city, were more likely to be willing to pay for the vaccination.

Table I Sociodemographic Sample Characteristics and Comparison Between Vaccine Sites

	Total	Vaccine Center City	Vaccine Center Rural	GP Practices City	GP Practices Rural	Comparison Between Sites
n	838	246	228	169	195	
Age	42.5±16.1	36.2±14.1	40.5±14.4	48.5±17.6	48.1±15.6	$H(3) = 72.526$ $p = <0.001$ $d = 0.66$
Gender						
Female	406 (51.4)	119 (50.0)	107 (50.2)	93 (57.8)	87 (48.9)	$\chi^2(6) = 5.574$ $p = 0.411$ $V = 0.063$
Male	380 (48.1)	117 (49.2)	104 (48.8)	68 (42.2)	91 (51.1)	
Diverse	4 (0.5)	2 (0.8)	2 (0.9)	0 (0.0)	0 (0.0)	
Education						
Primary	10 (1.2)	1 (0.4)	3 (1.3)	2 (1.2)	4 (2.2)	$\chi^2(6) = 24.960$ $p = <0.001$ $V = 0.124$
Secondary	560 (68.4)	143(58.4)	159 (70.7)	130 (78.8)	128 (69.6)	
Tertiary	249 (30.4)	101 (41.2)	63 (28.0)	33 (20.0)	52 (28.3)	
Employment						
Employed	563 (68.1)	176 (71.5)	175 (77.1)	99 (59.3)	113 (60.8)	$\chi^2(6) = 54.942$ $p = <0.001$ $V = 0.182$
Unemployed	132 (16.0)	45 (18.3)	38 (16.7)	18 (10.8)	31 (16.7)	
Retired	131 (15.9)	25 (10.2)	14 (6.2)	50 (29.9)	42 (22.6)	
Annual influenza vaccination						
Yes, always	204 (24.5)	33 (13.4)	38 (16.7)	63 (37.3)	70 (36.8)	$\chi^2(9) = 84.110$ $p = <0.001$ $V = 0.183$
Yes, mostly	115 (13.8)	30 (12.2)	25 (11.0)	24 (14.2)	36 (18.9)	
Yes, rarely	148 (17.8)	39 (15.9)	45 (19.8)	30 (17.8)	34 (17.9)	
No, never	365 (43.9)	144 (58.5)	119 (52.4)	52 (30.8)	50 (26.3)	

Note: Values for age represent mean and standard deviation. Values of other items represent n and percentage of valid cases (%). Bold values indicate a significant difference of $p < 0.05$.

Vaccine Site Preference and Its Relation to Participants' Concerns and Perceived Importance to Get the SARS-CoV-2 Vaccine

We further assessed participants' preference for a specific vaccine site in vaccine centers and GP practices. In GP practices, participants were asked to rate the importance to be vaccinated by their GP and how willing they were to also get vaccinated in a vaccine center. In vaccine centers, participants were asked if they would have preferred being vaccinated by a GP and if they would go to a vaccine center again for immunization (for more information see).⁴⁰ These items were correlated with participants' concerns regarding the vaccination and perceived importance. Results of the correlations are in Table 3.

Predicting Vaccination Skepticism

A multiple linear regression was calculated to predict vaccination skepticism based on reasons for vaccination, health risk concerns, perceived importance of the vaccine, self-efficacy, and demographic variables. We further calculated a new variable "GP preference" by merging "Preference to get vaccinated by a GP" (vaccine center participants) and "Importance to be vaccinated by GP" (GP practice participants) and included this variable in the model. The model explained 39.9% of the variation in vaccination skepticism ($F(12,646) = 35.708$, $p < 0.001$; Table 4).

Predicting Perceived Importance of Vaccination for Combating the Pandemic

A multiple linear regression was calculated to predict perceived importance of the COVID-19 vaccine for combating the pandemic, including demographic variables, reasons for vaccination, health risk concerns, and self-efficacy. The model explained 37.1% of the variation in the perceived importance ($F(8,685) = 50.534$, $p < 0.001$; Table 5).

Table 2 Reasons, Concerns, and Willingness to Pay for Vaccination and Comparison Between Sites

	Total	Vaccine Center City	Vaccine Center Rural	GP Practices City	GP practices Rural	Comparison Between Sites
Reasons for vaccination						
Infection protection	671 (81.1)	207 (84.8)	179 (78.9)	130 (80.2)	155 (81.2)	$\chi^2(3) = 3.028$ $p = 0.387$ $V = 0.061$
Recommendation by friends/family	76 (9.2)	23 (9.4)	29 (12.8)	8 (4.9)	16 (8.4)	$\chi^2(3) = 7.310$ $p = 0.063$ $V = 0.094$
Recommendation by GP	88 (10.6)	5 (2.0)	13 (5.7)	34 (20.6)	36 (18.8)	$\chi^2(3) = 58.231$ $p = <0.001$ $V = 0.258$
Benefits through vaccination	363 (43.9)	123 (50.4)	107 (47.1)	66 (40.0)	67 (34.7)	$\chi^2(3) = 12.797$ $p = 0.005$ $V = 0.124$
Societal expectations	69 (8.3)	27 (11.1)	22 (9.7)	9 (5.5)	11 (5.7)	$\chi^2(3) = 6.483$ $p = 0.090$ $V = 0.088$
Protection of others	602 (72.8)	194 (79.5)	162 (71.4)	111 (67.3)	135 (69.9)	$\chi^2(3) = 9.067$ $p = 0.028$ $V = 0.105$
Other reasons	46 (5.6)	9 (3.7)	16 (7.0)	11 (6.7)	10 (5.2)	$\chi^2(3) = 2.981$ $p = 0.397$ $V = 0.060$
Health risk concerns: I had concerns about the health risks of COVID-19 vaccines.						
1 = Strongly disagree	231 (29.6)	63 (25.9)	70 (32.0)	41 (27.0)	57 (34.1)	$\chi^2(12) = 17.392$ $p = 0.135$ $V = 0.086$
2 = Disagree	143 (18.3)	55 (22.6)	40 (18.3)	16 (10.5)	32 (19.2)	
3 = Neutral	216 (27.7)	73 (30.0)	55 (25.1)	48 (31.6)	40 (24.0)	
4 = Agree	118 (15.1)	32 (13.2)	34 (15.5)	30 (19.7)	22 (13.2)	
5 = Strongly agree	73 (9.3)	20 (8.2)	20 (9.1)	17 (11.2)	16 (9.6)	
Vaccination skepticism: I am generally skeptical about COVID-19 vaccines.						
1 = Strongly disagree	433 (54.8)	137 (56.6)	126 (57.3)	75 (48.1)	95 (55.2)	$\chi^2(12) = 22.347$ $p = 0.034$ $V = 0.097$
2 = Disagree	148 (18.7)	55 (22.7)	39 (17.7)	24 (15.4)	30 (17.4)	
3 = Neutral	103 (13.0)	25 (10.3)	29 (13.2)	29 (18.6)	20 (11.6)	
4 = Agree	50 (6.3)	15 (6.2)	14 (6.4)	8 (5.1)	13 (7.6)	
5 = Strongly agree	56 (7.1)	10 (4.1)	12 (5.5)	20 (12.8)	14 (8.1)	
Importance for oneself: How important is vaccination against COVID-19 for you?						
1=Not at all important 10=Very important	8.7±2.1	8.7±2.1	8.6±2.0	8.6±2.4	9.0±1.8	$H(3) = 5.150$ $p = 0.161$ $d = 0.103$
Quick vaccination: How important was it for you to be vaccinated against COVID-19 as soon as possible?						
1=Not at all important 10=Very important	7.5±2.9	7.2±2.8	7.5±2.6	7.5±2.9	8.3±2.2	$H(3) = 18.764$ $p = <0.001$ $d = 0.281$

(Continued)

Table 2 (Continued).

	Total	Vaccine Center City	Vaccine Center Rural	GP Practices City	GP practices Rural	Comparison Between Sites
Illness worries: The risk of getting seriously ill from COVID-19 worries me.						
I=Not at all 10=Very strongly	7.3±2.6	7.1±2.5	7.2±2.8	7.2±2.7	7.7±2.6	H(3) = 9.310 p = 0.025 d = 0.18
Risk before vaccination: How high did you perceive the risk of getting infected with COVID-19 before vaccination?						
I=Very low 10=Very high	6.2±2.6	6.1±2.4	6.1±2.6	6.2±2.7	6.4±2.7	H(3) = 1.015 p = 0.798 d = 0.10
Risk after vaccination: How high do you perceive the risk of getting infected with COVID-19 after vaccination?						
I=Very low 10=Very high	4.0±2.5	3.6±2.2	4.2±2.5	3.9±2.4	4.2±2.7	H(3) = 6.202 p = 0.102 d = 0.13
Self-efficacy: How do you rate your own influence (eg, wearing a mask, avoiding crowds) to avoid infection with COVID-19?						
I=Very low 10=Very high	7.7±2.4	7.8±2.2	7.7±2.5	7.6±2.6	7.6±2.4	H(3) = 0.391 p = 0.942 d = 0.11
Importance to combat: In your opinion, how important is a vaccine to combat the COVID-19 pandemic?						
I=Not at all important 10=Very important	9.1±1.7	9.3±1.5	9.1±1.7	8.8±2.0	9.2±1.7	H(3) = 5.329 p = 0.149 d = 0.11
WTP: Willingness to pay for vaccination						
Yes	402 (49.7)	144 (60.8)	106 (47.3)	68 (42.2)	84 (44.9)	$\chi^2(6)$ = 20.211 p = 0.003 V = 0.112
No	217 (26.8)	48 (20.3)	62 (27.7)	56 (34.8)	51 (27.3)	
Not sure	190 (23.5)	45 (19)	56 (25)	37 (23)	52 (27.8)	
Amount of money						
≤10€	84 (19.6)	28 (18.3)	20 (17.5)	19 (24.7)	17 (20.0)	$\chi^2(12)$ = 6.836 p = 0.868 V = 0.073
11–20€	149 (34.7)	55 (35.9)	42 (36.8)	27 (35.1)	25 (29.4)	
21–50€	137 (31.9)	50 (32.7)	33 (28.9)	21 (27.3)	33 (38.8)	
51–100€	31 (7.2)	10 (6.5)	9 (7.9)	5 (6.5)	7 (8.2)	
>100€	28 (6.5)	10 (6.5)	10 (8.8)	5 (6.5)	3 (3.5)	

Notes: Values for rating scales represent mean and standard deviation. Values of other items represent n and percentage of valid cases (%). Bold values indicate a significant difference of $p < 0.05$.

Predicting the Willingness to Pay for Vaccination

A multiple logistic regression was calculated to predict participants' WTP for the vaccination (yes, no) based on reasons for vaccination, vaccination skepticism, importance of a vaccination, perceived risk of getting infected with COVID-19, and demographic variables. The model explained 30.7% (Nagelkerke's R^2) of the WTP for vaccination (Wald $\chi^2(1) = 48.439$, $p < 0.001$; Table 6).

Discussion

Using a questionnaire, vaccinated individuals in German GP practices ($n = 364$) and mass vaccination centers ($n = 474$) were compared with regard to vaccine skepticism, concerns, and reasons for receiving a SARS-CoV-2 vaccine.

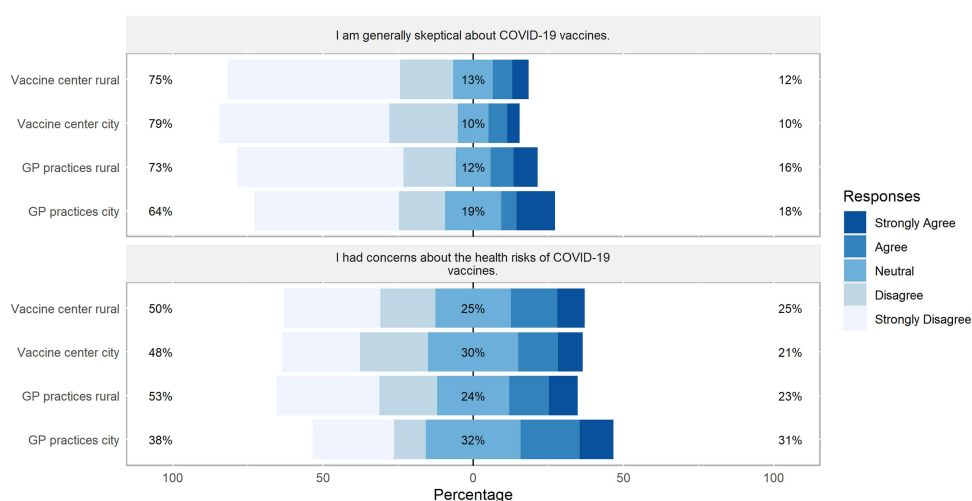


Figure 2 Differences between sites in participants' vaccination skepticism and health risk concerns. Percentages on the left and right side of the graph represent a summary of Strongly Agree and Agree on the right and Disagree and Strongly Disagree on the left side.

In vaccine centers, the benefits of vaccination and protection of others were more likely to be reasons for vaccination, whereas individuals in the GP practices were more likely to state that the GP's recommendation was a reason for vaccination. Participants in both sites preferring a GP for vaccination were more skeptical about the

Table 3 Correlations Between Vaccine Site Preference and Participants' Concerns and Willingness to Get the SARS-CoV-2 Vaccine

	Vaccine Centers		GP Practices	
	Preference to Get Vaccinated by a GP n = 465	Willingness to Go to a Vaccine Center Again n = 471	Importance to be Vaccinated by GP n = 332	Willingness to Get Vaccinated in a Vaccine Center n = 310
Concerns about the health risks of COVID-19 vaccines	−0.00	−0.04	0.13*	−0.12*
Generally skeptic about COVID-19 vaccines	0.14*	−0.20**	0.08	−0.13*
Importance of COVID-19 vaccination for oneself	0.00	0.25**	0.15*	0.22**
Importance of COVID-19 vaccination as soon as possible	0.03	0.16**	0.14*	0.21**
Worries of getting seriously ill from COVID-19	0.06	0.11*	0.26**	0.03
Perceived risk of getting infected with COVID-19 before vaccination	0.02	0.10*	0.19**	0.06
Perceived risk of getting infected with COVID-19 after vaccination	−0.01	0.01	0.14*	0.05
Own influence to avoid infection with COVID-19	−0.04	0.10*	0.09	0.18**
Importance of the vaccine to combat the pandemic	0.01	0.22**	0.10	0.21**

Notes: Vaccine site preference was rated on a 5-point Likert scale ranging from 1 = Strongly disagree to 5 = Strongly agree. Bold values indicate a significant difference of $p < 0.05$, with * = $p < 0.05$ and ** = $p < 0.001$.

Table 4 Multiple Regression Analysis Predicting Vaccination Skepticism

Predictor	B	SE B	β	R ²
Vaccination skepticism				
				0.399
Constant	2.919	0.347		
Age	0.009	0.003	0.117**	
Education	-0.027	0.078	-0.011	
Vaccination center/GP practice	0.025	0.084	0.010	
City/rural	0.058	0.075	0.024	
Reasons for vaccination: Infection protection	-0.250	0.118	-0.078*	
Reasons for vaccination: Societal expectations	0.280	0.135	0.065*	
GP preference	0.069	0.027	0.089*	
Health risk concerns	0.336	0.031	0.355**	
Importance for oneself	-0.133	0.026	-0.220**	
Illness worries	0.015	0.018	0.032	
Self-efficacy	-0.052	0.019	-0.095*	
Importance to combat	-0.098	0.032	-0.128*	

Notes: Durbin-Watson = 2.036. Bold values indicate a significant difference of $p < 0.05$, with * = $p < 0.05$ and ** = $p < 0.001$.

Table 5 Multiple Regression Analysis Predicting Perceived Importance of the Vaccine to Combat the Pandemic

Predictor	B	SE B	β	R ²
Importance of the vaccine to combat the pandemic				
				0.371
Constant	4.785	0.379		
Age	0.006	0.003	0.056	
Education	0.333	0.104	0.100**	
Vaccination center/GP practice	-0.248	0.106	-0.075*	
City/rural	-0.008	0.099	-0.002	
Reasons for vaccination: Infection protection	0.763	0.144	0.179**	
Reasons for vaccination: Protection of others	0.396	0.121	0.106**	
Illness worries	0.181	0.021	0.290**	
Self-efficacy	0.191	0.023	0.268**	

Notes: Durbin-Watson = 1.917. Bold values indicate a significant difference of $p < 0.05$, with * = $p < 0.05$ and ** = $p < 0.001$.

vaccine and more worried about getting seriously ill from COVID-19. In addition, vaccination skepticism was higher in older participants who also expressed more concerns about health risks of COVID-19 vaccines and lower perceived importance of the vaccine. However, no differences in vaccination skepticism between sites were independently found. The importance of the vaccine for combating the pandemic was rated higher by participants at vaccination centers, with a higher educational level, more self-efficacy, and an increasing need to protect others and themselves from serious illness. Participants in vaccine centers and who had attained a higher level of education were also hypothetically more willing to pay for a vaccine, especially when they were less skeptical and had a higher need to protect others and themselves. Our results indicate that GPs might indeed be better able to reach individuals with stronger vaccination hesitancy and, conversely, that individuals with higher vaccine skepticism might prefer to be vaccinated by a GP rather than at a vaccine center.

Table 6 Multiple Regression Analysis Predicting the Willingness to Pay for the Vaccination

Predictor	B	SE B	OR (95% CI)	R ²
Willing to pay for vaccination				
				0.307
Constant	-4.101	0.899		
Age	0.014	0.007	1.01 (0.99–1.03)	
Education	0.563	0.226	1.76 (1.13–2.73)*	
GP practice (Ref vaccination center)	-0.546	0.228	0.58 (0.37–0.91)*	
Rural (Ref city)	0.130	0.215	1.14 (0.75–1.74)	
Reasons for vaccination: Infection protection	0.545	0.315	1.73 (0.93–3.20)	
Reasons for vaccination: Benefits through vaccination	0.264	0.220	1.30 (0.85–2.00)	
Reasons for vaccination: Protection of others	0.651	0.258	1.92 (1.16–3.18)*	
Vaccination skepticism	-0.357	0.094	0.70 (0.58–0.84)**	
Risk before vaccination	0.128	0.046	1.14 (1.04–1.24)*	
Importance for oneself	0.219	0.071	1.25 (1.08–1.43)*	

Notes: Bold values indicate a significant difference of $p < 0.05$, with * = $p < 0.05$ and ** = $p < 0.001$.

Reasons for Vaccination

We examined participants' reasons for vaccination and potential differences between mass vaccination centers and GP practices. We found that participants at vaccine centers were more likely to state benefits through the vaccination and protection of others as reasons for vaccinations. Individuals in GP practices, in contrast, were more likely to state their GP's recommendation as a reason for vaccination. Previous studies have shown that protecting others is a strong motivator for receiving SARS-CoV-2 vaccines,^{43–46} even among hesitant individuals.⁴⁷ In addition, at the time of the survey, a full immunization offered everyday benefits, such as easier access to leisure and travel. Our results suggest that individuals in vaccine centers were more motivated to be vaccinated by anticipating more social benefits. As vaccinations in vaccine centers in our study required longer travel times compared to GP practices,⁴⁰ we can assume that individuals with a high level of motivation to protect others and to receive benefits would be more likely to seek a vaccination on their own initiative and would be willing to travel a further distance to a vaccine center. In contrast, GPs' long-term doctor-patient relationships, including with individuals who are less willing to receive a SARS-CoV-2 vaccine, might enable them to overcome some vaccination concerns. Provider recommendation has been shown to be an effective intervention to increase vaccine uptake,⁴⁸ a mechanism potentially influenced by trust³⁰ and effective patient-centered communication and education strategies.^{34,35}

Vaccination Skepticism and Vaccine Site Preference

As vaccination skepticism has been found to indirectly influence vaccination readiness⁶ and GPs might be better able to overcome these attitudes,^{25,27} we examined whether vaccination skepticism and concerns differed among participants who preferred a particular vaccine site. Although participants in GP practices were slightly more skeptical about the vaccine compared to participants in vaccine centers in a univariate analysis, we could not find general differences in vaccination skepticism between sites in a multivariate analysis, indicating additional interacting variables. Indeed, we found that regardless of site, vaccination skepticism was higher in older participants, who also expressed lower perceived importance of the vaccine and more health risk concerns of COVID-19 vaccines. The latter is in line with the findings of a systematic review, showing that vaccine safety concerns are a strong global predictor of vaccine hesitancy.⁴⁹ Importantly, GP preference was an additional predictor of higher vaccination skepticism in both vaccine sites. Our results might suggest that the vaccine site was not per se selecting vaccinees with more or less vaccine skepticism. Instead, it is conceivable that other factors might influence the decision to be vaccinated at a mass vaccination center, despite preference for a specific site or vaccination skepticism. For instance, our data were collected in summer of 2021, and touristic traveling required immunization in most cases. At the same time, GPs could order vaccines according to

their needs, but only in limited quantities, resulting in low capacity for high demand. Therefore, it is likely that even vaccine-hesitant individuals with a preference for a GP would register at the vaccination centers to prepare for the upcoming holidays in time, which is supported by studies showing that travel intentions might encourage even vaccine-hesitant individuals to receive a vaccine.^{47,50} In addition, social pressure from relatives or friends has been found to be a strong motivator for vaccination, even among hesitant individuals.⁴⁷ The fact that more skeptical individuals would prefer to be vaccinated by a GP, however, indicates that the established relationship between patient and GP might be beneficial in reaching vaccine-hesitant individuals, as has been suggested elsewhere.^{25,27,51,52} Consistent with this, studies found that the SARS-CoV-2 vaccination coverage was positively associated with provider recommendation⁵³ and with the number of GPs per capita, even in regions with higher vaccination hesitancy.²⁸

The association between older age and increased vaccination skepticism contrasts with the findings of other studies (see reviews,^{12,14}) which mainly report higher vaccination hesitancy in younger individuals. However, a global systematic review also showed contradictory results with respect to age and vaccination hesitancy.⁴⁹ In our study, this effect might be due to the timing of the survey, as the data were collected when prioritization of more vulnerable groups, such as older people with co-morbidities, had already been suspended. At the time of our survey, the remaining older individuals might have been more reluctant to receive the vaccine in the earlier phases, while those more willing to receive the vaccine had already gone through the process and could not be captured in our study. A potential explanation for our finding might therefore be the known association between older age and increasing conservatism.^{54,55} Conservatism, conversely, has been found to be associated with lower vaccine uptake and more vaccination hesitancy or skepticism.^{49,56,57} However, future studies should examine the relationship between older age, conservatism, and vaccination skepticism in more detail.

Perceived Importance of the Vaccine

We further found that the perceived importance of the vaccine in combating the pandemic was higher among individuals with higher education and in vaccine centers. Individuals who stated that the vaccine is important to overcome the pandemic also more often expressed their own and others' infection protection as the main reasons for vaccination, worries of getting seriously ill from COVID-19, and higher own influence over avoiding infection with COVID-19 (self-efficacy). Our results suggest that especially individuals with a high health awareness (indicated by wanting to protect against infection and worrying about getting ill) and health self-efficacy were more likely to consider the vaccine as important for ending the pandemic. This resonates with pre-pandemic findings showing that a health-promoting behavior was predicted by health self-efficacy and health values.⁵⁸ Self-efficacy, but also risk perception and outcome expectancies, have also been found to be associated with influenza vaccination intentions.^{59,60} With respect to COVID-19, perceived benefits and severity of the novel disease were found to be positively associated with higher vaccine acceptance.^{61–63} Another study found that individuals with higher risk perception of COVID-19 also expressed higher self-efficacy,⁶⁴ suggesting that higher perceived risk might modulate behavioral adaptations. As all individuals included in our study received a vaccine, we could not directly measure vaccination intention in this population, but only the importance attributed to the vaccine to combat the pandemic. However, it has been shown that the perceived importance of the SARS-CoV-2 vaccine increased vaccination intentions and acceptance.^{65–67} Thus, supported by our results, both parameters (risk perception and self-efficacy) might promote protective measures, and, in turn, the importance attributed to vaccination, as it can be seen as an opportunity for action.

Willingness to Pay

Lastly, we examined participants' hypothetical WTP for the vaccination as a measure of the perceived value attributed to COVID-19 vaccines. We found that participants with a higher level of education and in vaccine centers were more willing to pay for the vaccine. Further, protecting others as a reason for vaccination, perceived risk of getting infected with COVID-19, and perceived importance of the vaccine for oneself increased the WTP, whereas vaccination skepticism markedly decreased the WTP. A recent review identified, among others, sociodemographic characteristics, perceived threat, and perceived benefit as determinants of the WTP for health care services.⁶⁸ With respect to COVID-19, a higher educational level^{69,70} and the perceived threat of the pandemic⁷¹ have been found to increase the amount of money people are willing to

pay for SARS-CoV-2 vaccines. In contrast, lower trust in the government was associated with a decrease in the amount of money people were willing to pay for SARS-CoV-2 vaccines.⁶⁹ However, apart from the specific individual determinants of the WTP replicated in our study, we also found that these individuals were more likely to get vaccinated at a vaccine center. Consistent with the results discussed above regarding the perceived importance of the vaccine in combating the pandemic, individuals who would spend money on a vaccine, and, thus, might place a higher value on it, were more likely to accept a potentially longer travel time to the vaccine center.⁴⁰ Conversely, individuals who placed a lower value on the vaccine were more likely to be vaccinated in a GP practice, strengthening our argument that GPs may be better able to reach individuals with lower motivation to get vaccinated against COVID-19. This might also be due to the fact that vaccinations were offered at the GP practice during consultations for other reasons, whereas vaccination at the vaccine center required additional time and effort.

Limitations

Our study has limitations. Although we measured vaccination skepticism, we cannot fully account for vaccination skepticism in the general population, as all individuals who completed the questionnaire were vaccinated, indicating potentially lower skepticism in this group. In addition, the data were assessed when the prioritization of specific groups had already been suspended, which implies that the results might have differed at the beginning of the immunization campaign. In particular, the survey period coincided with the 2021 summer holiday season, which may have led to a shift in motivation to vaccinate to comply with travel regulations at both types of vaccination sites. Further, participants did not fill in the questionnaire at the same timepoint, instead ranging from July 2021 to October 2021. Temporary differences, such as case incidences of COVID-19, subjective perception of the pandemic's progression, or holiday seasons, might have influenced participants' reports over time. In addition, all answers were self-reports and might be imprecise due to subjective perceptions. Importantly, our questionnaire is not a validated scale as we did not develop and assess several items measuring a construct related to motivation, vaccine skepticism, or perceived importance, but rather investigated single item responses.

Lastly, the study was conducted in one federal state in Germany. Socio-demographic differences between federal states in Germany as well as between European countries limit the generalizability of our findings. Further, the varying access to mass vaccination centers/GPs, availability of vaccines, case incidences, and vaccination willingness in Europe and other parts of the world might impede comparability.

Implications

Our study contributes to a better understanding of vaccination preferences and reasons in individuals with varying degrees of vaccination skepticism. The present results indicate that GPs might be both able to convince more vaccination hesitant and less motivated individuals and, conversely, be the preferred option for more skeptical individuals. We argue, in line with previous research,^{25–27,30,53} that especially the trust gained in a long-term doctor-patient relationship might significantly increase vaccine uptake in more hesitant individuals. In contrast, mass vaccination centers might be more likely to attract individuals with stronger intrinsic motivations, such as risk perception, higher health values, protection of others and self, and with higher self-efficacy. Considering the national vaccination campaign in Germany 2021, GPs were included in the vaccination strategy at a later stage after implementing mass vaccination sites. Our results therefore suggest the following opportunities for future vaccination campaigns: 1) In a future mass vaccination event, the rapid involvement of GPs in parallel with mass vaccination sites might enhance the vaccine uptake across broad socio-demographic groups. 2) As self-efficacy and risk perception might promote protective behaviors, framing vaccination as an opportunity to act to protect others and oneself might be beneficial in future vaccination campaigns to overcome attitudinal barriers. In turn, the provision of sufficient health-related information could increase self-efficacy and, thus, confidence in making informed choices. Through their long-term relationship with patients, we suggest that especially the provision of health information by GPs can play a crucial role in influencing patients' vaccination decisions. These framings need not be restricted to vaccination behavior, and could potentially be used to promote other favorable health behaviors as well. 3) Our results also suggest that social and leisure benefits might increase vaccine uptake. In future vaccination campaigns, these benefits could be explicitly emphasized. 4) Lastly, vaccination skepticism is not restricted

to COVID-19 vaccines and other infectious diseases have recently been on the rise (eg, polio and measles). GPs might be able to reduce vaccination hesitancy for various infections through effective but time-consuming patient-centered communication strategies.^{31–33,35} To fulfill this role, better support and recognition for the important role they play in immunizing their communities is urgently needed (eg, financial improvements of the billings and more time to discuss potential concerns during appointments).

Conclusion

Attitudes towards SARS-CoV-2 vaccination have significantly curbed vaccine uptake worldwide. In this study, we examined whether participants' reasons for vaccination, concerns and skepticism about vaccination, and perceived importance of the vaccine and its hypothetical value would differ between mass vaccination sites and GP practices. We found that reasons for vaccination were more prosocial and benefit-oriented among those who attended vaccine centers. In the same line, both the perceived importance of the vaccine for combating the pandemic and its hypothetical value were rated higher among individuals at vaccine centers, indicating opportunities for framing future vaccination campaigns that include large-scale uptake at mass vaccination centers. We also confirm that individuals with more vaccination skepticism and concerns more often preferred a GP to administer the vaccine, suggesting that a rapid involvement of GPs in future mass vaccination events might be crucial for overcoming attitudinal barriers. Our findings provide insights into how future vaccination campaigns could be designed to achieve higher vaccine uptake and to optimally meet individual attitudes in all population groups.

Acknowledgments

We thank participating GPs, vaccine centers, and vaccinated individuals for their support. For assistance and help during the preparation of the study, we thank Britt Häusler and Nathalie Mähl. We thank André Jentzsch for support with the graphical representation of the results. For proofreading we thank Dawn M. Bielawski.

Disclosure

All authors would like to disclose that data from the same cohort of participants were previously published in the journal *Vaccines* (<https://www.mdpi.com/2076-393X/10/11/1823>). In this previous study, other variables from the same sample were reported. The present study is based on the same cohort of participants (n = 838), but consists of new variables related to vaccine attitudes that have not been reported before.

The authors acknowledge support from the German Research Foundation (DFG) and Leipzig University within the program of Open Access Publishing. The authors have no relevant financial or non-financial interests to disclose.

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