Factors that impact acceptance of COVID-19 vaccination in different community-dwelling populations in China

Jinhua Pan

Fudan University

Kezhong A

Qinghai Center for Disease Prevention and Control

Zhixi Liu

Fudan University

Peng Zhang

Huzhou Center for Disease Prevention and Control

Zhiyin Xu

Minhang Center for Disease Prevention and Control

Xiaoqin Guo

Songjiang Center for Disease Prevention and Control

Guangtao Liu

Huzhou Center for Disease Prevention and Control

Ao Xu

Fudan University

Jing Wang

Xi'an Jiaotong-Liverpool University

Xinyu Wang

Fudan University

Wei-bing Wang (✉ wwb@fudan.edu.cn)

Fudan University <https://orcid.org/0000-0002-4497-5251>

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Abstract

Background

It is important to improve vaccination strategies and immunization programs to achieve herd immunity to infectious diseases, particularly in general community-dwelling populations.

Methods

To assess the acceptance of COVID-19 vaccination, we conducted face-to-face surveys and online surveys in Shanghai, Zhejiang, and Qinghai province. A fixed effects model and a random effects model were used to analyze factors associated with acceptance of COVID-19 vaccination.

Findings

The results indicated that 82.6% of participants (77.0% in Shanghai and 87.3% in Zhejiang) were willing to receive vaccination when it was available in the community, and 57.2% of deliverymen, 43.3% of medical workers, 78.2% of parents of primary and secondary school children, and 72.2% of parents of preschool children were willing to receive vaccination. The models showed that participants who were male, 60 to 69 years-old, from rural areas, had less education, had good health status, and had positive attitudes and trust in vaccines approved by National Health Commission were more likely to accept vaccination. Participants also had increased vaccination acceptance if it was recommended by government sources, doctors, relatives, or friends. Most participants learned about COVID-19 vaccination from television, radio, and newspapers, followed by community or hospital campaigns and the internet. Those who did not want to receive vaccination were mainly concerned about safety (288, 59.6%) and efficacy (196, 40.6%).

Conclusions

Government sources and doctors could increase acceptance of vaccination by promoting the efficacy and safety of COVID-19 vaccination by use of mass media and emphasizing the necessity of vaccination for everyone.

Introduction

The current 2019 coronavirus disease (COVID-19) pandemic, caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), accounts for a significant amount of the total global disease burden (1, 2). As of 14 May 2021, there were 161,367,221 confirmed cases worldwide, and 103,938 cases in China. To slow the spread of infection and mitigate the adverse health effects, public health administrations in many countries have implemented various control measures, such as quarantine,

partial and comprehensive lockdown, closing of schools and businesses, and promoting mask-wearing in public areas (3). Although these measures were helpful, resurgences of COVID-19 were reported in many regions after resumption of normal activities (4–6), thus indicating an urgent need for effective long-term preventive measures. COVID-19 vaccination is generally considered the most effective method to control the spread of this disease (4). At present, more than ten COVID-19 vaccines were approved for marketing in different countries (7), and numerous countries have successfully implemented vaccination programs, including China and the United States. Although many countries have achieved significant progress, two major challenges must be overcome: poor public acceptance of vaccination and implementation of interventions that increase public acceptance of vaccination (8).

Many previous studies have examined public acceptance of COVID-19 vaccination. For example, Reiter *et al* (9) stated that 69% of participants in the United States were willing to receive COVID-19 vaccination. Harapan *et al* (10) found that 93.3% of individuals in Indonesia were willing to receive a vaccine that had 95% effectiveness, but only 67.0% were willing if the vaccine had 50% effectiveness. Lazarus *et al* (11) reported that people from China had the highest acceptance of COVID-19 vaccination (88.6%) and Poland had the lowest acceptance (27.3%). However, these studies were all conducted online, and thus excluded people without internet accesses. Moreover, because almost all of these studies were web-based, this may have compromised the quality of survey and led to population biases.

However, the real COVID-19 vaccination uptake rate could be much lower than the acceptance after introducing the vaccine and promoting mass immunization programs (8). Identification of factors related to acceptance or rejection of COVID-19 vaccination is essential for the design of strategies that improve vaccine coverage in general populations. Some previous studies found that positive attitudes about COVID-19 vaccination were associated with learning about vaccination from government sources, male sex, educational attainment, increased frequency of flu vaccination, and having health insurance (8, 12). However, these were online surveys that used a fixed effect model for analysis, and did not consider the effect of geographic among participants.

Our general purpose was to provide a more comprehensive understanding of the public acceptance of COVID-19 vaccination and the factors that influence its acceptance. Thus, we performed face-to-face interviews to assess vaccine acceptance in general community-dwelling populations and a larger online survey to assess the attitudes of healthcare workers, deliveryman, the parents of preschoolers, and the parents of primary and secondary school students. We then used a fixed effect model and a random effect model to analyze the data. This approach is critical for the development of improved strategies that promote acceptance of COVID-19 vaccination, particularly the vaccination of individuals living in the general community. A comparison of the results of this study with those of previous studies may help to identify changes in the acceptance of vaccination at different times and in different populations.

Materials And Methods

Ethics statement

The Ethics Committee of the School of Public Health of Fudan University approved this study (Approval no: IRB#2020-11-0758) and all participants provided written informed consent.

Study sites

Between December 2020 and April 2021, face-to-face surveys targeting the general population were performed in Shanghai and Huzhou (Fig. 1), cities that have very different characteristics. Shanghai is a wealthy and highly connected international hub with a high population density and has experienced continuous importations of COVID-19 cases. Huzhou is a middle-sized city that has a more modest average income and a lower population density. These face-to-face interviews were conducted in two districts of Shanghai (Songjiang and Minhang district) and in four districts of Zhejiang (Nanxun, Anji, Deqing, and Changxing). Online surveys were also conducted in Shanghai, Huzhou, and Qinghai (a remote region with a low population density and a low average income).

Sampling

For the face-to-face survey, 120 neighborhoods were sampled using multi-stage stratified sampling that was proportional to population size (Figure S1). Then a convenience sample of 25 households per neighborhood was selected as broadly representative of the geographic characteristics of the whole neighborhood population (Figure S2). One person from each household was invited to participate until there were 2966 participants with appropriate age and gender distribution (Sampling design and study population, Supplementary Text 1). Individuals of all ages who were living in the selected neighborhoods more than 2 weeks and did not intend to move from these districts during the following 2 weeks were eligible for inclusion.

For the online survey, four key populations were selected from Shanghai, Huzhou, and Qinghai, so that each level of hospital (primary, secondary, tertiary) was considered (Supplementary Text 1). Healthcare workers, cold chain transportation workers, takeaway workers, and couriers were selected as the key populations. Two to four kindergartens were selected as clusters within each region using simple random sampling (SRS, Supplementary Text 1&2 for sampling and school details) and two to four senior high schools, junior middle schools, and primary schools were also selected in each region (Supplementary Text 1&2 for sampling and school details). One class from each grade was selected in each senior high, junior-middle school, and primary school. Each online survey participant voluntarily signed an informed consent agreement. The target sample size was 1483 for each category. (Supplementary Text 1 for population details can be seen in Supplementary Text 1).

Data collection

Face-to-face survey

After signing the informed consent document, each participant received a questionnaire that was developed based on previous research (10, 13–20) and guidance of experts from Fudan University,

Zhejiang University, and Duke University. A direct face-to-face interview was performed by investigators who received the same training (Quality control, Supplementary Text 1).

The questionnaire collected information on demographics (region of residence, age, sex, level of education, income, basic diseases, and occupation); knowledge, attitudes, and acceptance of COVID-19 vaccination; and willingness to pay for vaccination. Participants were asked the following general question: 'If a COVID-19 vaccine was free and available to you, would you take it?', and were then asked to register their level of agreement to the following response: 'I would follow doctor's, government's, relatives', and friends' recommendation to get a COVID-19 vaccine once the government has approved it as safe and effective'. The level of agreement to this response was rated using a six-point Likert scale ('completely possible', 'somewhat possible', 'neutral/no opinion', 'somewhat impossible', 'completely impossible', and "I don't know").

Each participant's knowledge of COVID-19 vaccination and their reasons for accepting vaccination were also examined. The attitudes about two COVID-19 vaccines were determined: the domestic vaccine (approximately 80% effective) and the imported vaccine (approximately 95% effective). The acceptance and willingness of the participant to pay for vaccination of himself/herself, his/her children, and elderly family members (≤ 60 years-old) were assessed for each vaccine. Information about whether the participant or a family member was sickened or died from COVID-19-, was on the 'front lines' during implementation of pandemic control and treatment measures, was in quarantine because of contact history, the distance from the participant's home to the nearest vaccination site, and the number of years the participant lived in the sampled area were recorded.

The responses to different questions were determined for different groups defined by age (< 30, 30–39, 40–49, 50–59, 60–69, and > 70 years-old), gender (male, female), education level (less than high school [low], high school or technical secondary school [medium], bachelor's degree or above [high]), marital status (married, other [single, divorced or widowed]), and employment status (employed, unemployed [full-time housewife, retired, and unemployed]). In addition, questions were used to assess knowledge (4 questions), attitude (2 questions), and behavior (5 questions) related to COVID-19 vaccination (Questions about knowledge, attitude and behavior, Supplementary Text 1). A correct answer was scored as '1', an incorrect answer as '0', and total scores were determined for knowledge, attitude, and behavior.

Online survey

After signing the informed consent agreement, participants in the online survey completed the questionnaire online. This questionnaire was simpler than the face-to-face questionnaire, and collected information demographic information (age, sex, level of education, income, and occupation). The general vaccine-related question was, 'If a COVID-19 vaccine was free and available to you, would you take it?'.

Statistical analysis

Categorical variables were expressed as proportions and continuous variables as means (standard errors). Multilevel logistic regression and simple logistic regression were used for analysis. An outcome

was defined as '1' for an answer of 'completely agree' or 'somewhat agree', and '0' for any other response (Statistical analysis, Supplementary Text 1). For missing data, a random forest model was used for imputation (mice package and RandomForest package in R). Bootstrapping was used to estimate 95% confidential intervals of vaccine acceptance. All data analyses were conducted using R version 3.6.0.

Results

Demographic characteristics of participants

We initially recruited 3173 participants. A total of 2769 of these individuals (87.3%) did not receive COVID-19 vaccination and completed the full questionnaire in the face-to-face survey (Figure S3). Among these 2769 participants, 1286 (46.6%) were female, 1469 (53.0%) were from rural regions and 1300 (46.9%) were from urban areas (Tables S1 and S5), and 25.7% had incomes of more than 50 to 100 thousand Chinese yuan per year. More than half of the respondents (53.2%) had 'low level' of education (completion of junior high school or less). The mean age was 45.95 years, and there were similar numbers of participants in the different age groups (Figure S4).

We also conducted an online survey in Shanghai, Qinghai, and Huzhou to determine the acceptance of vaccination by delivery workers, healthcare workers, parents of preschoolers, and parents of primary and secondary school students ($n = 20,595$). Among these participants, 2879 were delivery workers, 4852 were parents of preschoolers, 3826 were healthcare workers, and 9038 were parents of primary and secondary school students. A total of 17,206 of these individuals (1335 delivery workers, 2001 healthcare workers, 4847 parents of preschoolers, 9017 parents of primary and secondary school students) completed the full questionnaire and passed the audit based on verification questions (Figure S3), which included naming the capital of China, work unit, birth date, and geographic location (verified by comparison with the internet protocol address).

Most of the delivery workers were male (85.6%), more than half of them had a 'low level' of education (50.2%), and 40.8% had incomes below 10,000 yuan in 2019. Most of the healthcare workers were female (76.9%), more than half of them had a 'high level' of education (90%), and 27.7% had incomes of 30,000 to 100,000 yuan in 2019. Among the parents of preschoolers, 52.4% were male and 22.6% had incomes of 500,000 to 1,000,000 yuan in 2019. Among the parents of primary and secondary school students, 51.9% were male and 22.6% had incomes of 100,000 to 300,000 Chinese yuan in 2019.

Vaccine acceptance in different populations

Our analysis of participants in the face-to-face survey indicated that 2286 (82.6%) of them would accept vaccination if a 'free and effective' COVID-19 vaccine was available (Fig. 2). There were more positive responses in Zhejiang (1298/1486, 87.3%, $p < 0.0001$) than in Shanghai (988/1283, 77.0%).

Among the four key groups in the online survey, 57.2% of delivery workers, 43.3% of healthcare workers, 78.2% of the parents of primary and secondary school students, and 72.2% of the parents of preschool

children indicated they would accept vaccination (Fig. 2). Notably, the parents of primary and secondary school students had the most positive responses (7052/9017, 78·2%), and healthcare workers had the fewest positive responses (867/2001, 43·3%). We also explored the acceptance rate under two different hypotheticals vaccination scenarios that considered vaccine origin and efficacy, and the probability of adverse reactions (Results, Supplementary Text 1).

Methods to improve acceptance of vaccination

We assessed the sources of each participant's knowledge about influenza vaccination in the face-to-face survey. Among the 2769 participants, 93 (4·2%) knew little about the flu vaccine; 1465 (66%) learned about the flu vaccine from publicity provided by the local community or hospital; 1007 from newspapers, videos, or television; 810 from the internet (QQ, WeChat, Weibo, news websites, etc.); 507 from family and friends; and 36 from other sources. In contrast, knowledge about COVID-19 vaccination was mainly from television, videos, and newspapers (1619, 58·5%), followed by community or hospital campaigns (1270, 45·9%), the internet (1188, 42·9%), family and friends (723), and other sources (2). Sixteen participants said they knew nothing about COVID-19 vaccination (Fig. 3). The vaccination acceptance rate was greater for those who learned about it from government publicity and suggestions by a doctor, relative, or friend, but was less for those who worried about vaccine safety (Fig. 4).

Among the 2235 (80·7%) participants who did not receive the influenza vaccine, 843 (37·72%) said they were in good health and did not need it, 370 (16·55%) said they were unlikely to get influenza, 195 (8·72%) believed that only children needed the vaccine, 470 (21·03%) worried about vaccine safety, 170 (7·61%) reported it was too expensive, 380 (17·00%) worried about the efficacy, 436 (19·51%) never heard about the vaccine, and 334 (14·94%) did not know where to get the vaccine (Fig. 4). Thus, the major reason participants did not receive the influenza vaccine is that they thought it was unnecessary because they already had good health status and concerns about the vaccine safety (Fig. 4).

Among the 483 participants (17·44%) who refused or were hesitant about COVID-19 vaccination, most were worried about safety (288, 59·63%) and efficacy (196, 40·58%). Additionally, 75 (15·53%) participants thought they were in good health and did not need the vaccine, 69 (14·29%) believed they had a low risk of infection, 48 (9·94%) worried about the high price, 30 (6·21%) did not know where to get the vaccine, 9 previously had poor vaccination experiences, and 71 (14·70%) had other reasons, such as old age, presence of a chronic disease, and other factors (Fig. 4).

The simple logistic and multilevel logistic models indicated that males were more likely to accept COVID-19 vaccination than females (Table 4). In addition, those with a 'low level' of education more likely to accept the COVID-19 vaccine than those with a 'medium level' of educational. Relative to participants with poor health, those with good health were less likely have negative views of COVID-19 vaccination (simple logistic model: OR = 0·35, 95 CI% (0·15, 0·88); multilevel logistic model: OR = 0·36, 95 CI% (0·15, 0·88)). Higher attitude and behavioral scores were also associated positively with vaccine acceptance. Those who did not know whether to choose an imported or domestic vaccine were less likely to accept vaccination than those who preferred the imported vaccine. The logistic model indicated that participants

from rural areas were more likely to accept vaccination than those from urban areas (OR = 0.59, 95% CI (0.44, 0.79)). The multilevel logistic model indicated that participants aged 60 to 69 years were more likely to accept vaccination than those less than 30 years-old (OR = 0.52, 95% CI (0.29, 0.92)).

Discussion

We investigated the acceptance of COVID-19 vaccination and identified factors related to this acceptance using an online survey and a face-to-face survey of different community-dwelling populations in China. The results indicated that acceptance varied among different groups within a population and also among different populations. In particular, a comparison of general community populations indicated greater acceptance of vaccination in Zhejiang (87.3%) than in Shanghai (77.0%). A comparison of different groups within populations indicated that acceptance was greatest among parents of primary and secondary school students (78.2%), and lowest among medical workers (43.3%). The low vaccination rate of medical workers may be due to the fact that some medical workers had been vaccinated at the time of our survey. By adding up the vaccinated people and the unvaccinated people who were willing to be vaccinated, the vaccination rate of medical workers was calculated to be 86.8%. Similarly, at the time of the survey, some of the delivery workers had been vaccinated. We added up those who had been vaccinated to calculate the final vaccination rate of the delivery workers was 84.6%. In contrast to previous studies (21, 22), we investigated willingness to be vaccinated in different groups of people. Given that many people living in the community do not use mobile phones, our combined use of a face-to-face and online survey provided a more reliable assessment of vaccine acceptance in the general community and stronger scientific basis for developing vaccination policies for general communities. Our results indicated a strong desire for vaccination in the general community, suggesting support for large-scale vaccination programs. The administration of hundreds of millions of vaccines may present a significant logistical challenge to the government and policymakers in China. Therefore, we suggest there should be a focus on the establishment of vaccination sites and the rapid allocation of vaccination resources and other preparations to prevent shortages of vaccines so that rapid population immunity can be established.

Identification of factors that influence acceptance of COVID-19 vaccination — both barriers and facilitators — is important for the design of effective strategies that improve vaccine coverage in the general community. We found that males had a stronger acceptance of vaccination than females, possibly because previous studies reported greater risks of complications and death due to COVID-19 in males than females (23). Similarly, we also observed greater acceptance of vaccination in people aged 60 to 69 years than those under 30 years-old, possibly because there are greater risks of complications and death due to COVID-19 in the elderly (12). These results suggest that many people may misunderstand that having a somewhat lower risk of complications or death from COVID-19 means that they can ignore the need for vaccination. Therefore, future vaccination campaigns should guide the entire public to understand the importance of vaccination and universal coverage for establishing population-wide immunity, and that it is necessary to include individuals who are not in high-risk groups. In the face of the COVID-19 pandemic, it is unrealistic to maintain a prolonged lock-down strategy, because this will

lead to significant economic burden and other problems. We found that people with more education and those from urban areas were less likely to accept vaccination, suggesting the need to focus on these groups to improve vaccine coverage, which is consistent with the previous studies (11).

Our survey confirmed that general community-dwelling populations had greater trust in COVID-19 vaccines that were approved by the National Health Commission and believed that vaccination was an effective protective measure. Furthermore, participants who were concerned about their own health and kept a positive attitude were more likely to accept vaccination. This could be because the Chinese government and medical workers outwardly expressed confidence, reliability, and credibility in their promotions of vaccination. Thus, within a year since the onset of the COVID-19 pandemic, there has been increased awareness of the need for self-protection (wearing masks, frequent hand washing, maintaining social distance, *etc.*) and a decreased use of public transportation. These measures also helped to decrease the incidence of other respiratory infectious diseases. We found that people with a strong sense of self-protection were more likely to comply with prevention and control recommendations from the government.

In addition to building public trust, reliable sources of information and guidance are crucial for vaccine mobilization and disease control (24). Our results indicated that in contrast to previous vaccines, the public acquired most of its information about COVID-19 vaccination from television, radio, newspapers, hospital publicity, and the internet. Moreover, recommendations from the government, doctors, friends, and relatives increased the acceptance of vaccination; the government and doctors had the greatest impact, and vaccine information from these two sources increased the acceptance of vaccination to nearly 90%.

This study had some limitations. In particular, this was a cross-sectional survey, and the acceptance of vaccination in a population is likely to change over time. Therefore, acceptance of vaccination during different periods should also be analyzed for comparison. Importantly, the acceptance of vaccination reported herein can be compared with previous and future studies.

Conclusion

At present, the COVID-19 epidemic in China is mostly under control and there is widespread acceptance of vaccination, especially in community-dwelling individuals. We found that men, rural residents, and those with less education were more likely to accept vaccination. Governments will have to introduce new strategies to persuade females, those with more education, and urban residents to accept vaccination. Among individuals who were vaccine refusers or hesitators, most were worried about vaccine safety and efficacy. Most people obtained knowledge about COVID-19 vaccination from television, videos, and newspapers, followed by community or hospital campaigns, and then the internet. Recommendations from the government, doctors, friends, and relatives increased the acceptance of vaccination. Therefore, we suggest that increasing the success of mass vaccination campaigns and public acceptance of vaccination, especially for females, urban residents and those with more education, can be achieved if

governments and doctors promote the efficacy and safety of vaccines using television, radio, and the internet to emphasize the importance universal vaccination.

Declarations

Ethics approval and consent to participate

The Ethics Committee of the School of Public Health of Fudan University approved this study (Approval no: IRB#2020-11-0758) and all participants provided written informed consent.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests

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Author contributions

Jinhua Pan: Conceptualization, Methodology, Software, Formal analysis, Investigation, and Writing - Original Draft. **Kezhong A:** Investigation, and Writing - Original Draft. **Zhixi Liu:** Methodology, and Software. **Peng Zhang:** Investigation, and Writing - Review & Editing. **Zhiyin Xu:** Investigation, and Writing - Review & Editing. **Xiaoqin Guo:** Investigation, and Writing - Review & Editing. **Guangtao Liu:** Investigation, and Writing - Review & Editing. **Ao Xu:** Investigation, and Writing - Review & Editing. **Jing Wang:** Investigation, and Writing - Review & Editing. **Xinyu Wang:** Investigation, and Writing - Review & Editing. **Weibing Wang:** Conceptualization, supervision, funding acquisition and writing-review and editing. All authors critically reviewed and approved the final version of the manuscript. The corresponding authors are responsible for ensuring that the descriptions are accurate and agreed by all authors.

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Tables

Table 1
Description of the participants

	Community residents	Deliverymen	Health workers	Parents of preschoolers	Parents of school students
	N = 2769	N = 1335	N = 2001	N = 4847	N = 9017
age (mean (SD))	45.95 (19.29)	31.52 (7.45)	34.70 (9.46)	4.61 (1.51)	11.21 (3.55)
Province (%)					
Zhejiang	1283 (46.3)	317 (23.7)	534 (26.7)	2127 (43.9)	1206 (13.4)
Qinghai	1486 (53.7)	68 (5.1)	779 (38.9)	1996 (41.2)	7251 (80.4)
Shanghai		950 (71.2)	688 (34.4)	724 (14.9)	560 (6.2)
Sex (%)					
Female	1483 (53.6)	232 (17.3)	1539 (76.9)	2305 (47.5)	4341 (48.1)
Education (%)					
Low	1390 (50.2)	520 (39.0)	35 (1.7)	N/A	N/A
Median	542 (19.6)	558 (41.8)	156 (7.8)	N/A	N/A
High	755 (27.3)	257 (19.0)	1810 (90.5)	N/A	N/A
Income (thousand Chinese Yuan, %)					
< 10	574 (20.7)	545 (40.8)	376 (18.8)	959 (19.8)	3490 (38.7)
10–30	587 (21.2)	192 (14.4)	277 (13.8)	759 (15.7)	2065 (22.9)
30–50	648 (23.4)	239 (17.9)	266 (13.3)	746 (15.4)	1472 (16.3)
50–100	711 (25.7)	288 (21.6)	544 (27.2)	1096 (22.6)	1165 (12.9)
100–200	195 (7.0)	59 (4.4)	456 (22.8)	781 (16.1)	530 (5.9)

*School children: students in primary and secondary schools

	Community residents	Deliverymen	Health workers	Parents of preschoolers	Parents of school students
> 200	54 (2·0)	12 (0·9)	82 (4·1)	506 (10·4)	295 (3·3)
*School children: students in primary and secondary schools					

Table 2
Impact factors associated with COVID-19 vaccine acceptance

	Univariate logistic model		Multivariate logistic model	
	Adjusted OR (95% CI)	Crude OR (95% CI)	Adjusted OR (95% CI)	Crude OR (95% CI)
Sex: female vs. male	1.48 (1.12, 1.96) [†]	1.56 (1.28, 1.91) [†]	1.49 (1.12, 1.98) [†]	1.55 (1.27, 1.90) [†]
Age				
30–39 vs. <30	0.77 (0.48, 1.23)	0.84 (0.61, 1.16)	0.76 (0.47, 1.22)	0.86 (0.62, 1.18)
40–49 vs. <30	0.82 (0.49, 1.35)	0.72 (0.51, 1.00)	0.78 (0.47, 1.30)	0.80 (0.57, 1.12)
50–59 vs. <30	0.88 (0.53, 1.48)	0.60 (0.43, 0.84) [†]	0.83 (0.49, 1.40)	0.66 (0.47, 0.92) [†]
60–69 vs. <30	0.58 (0.32, 1.02)	0.78 (0.56, 1.08)	0.52 (0.29, 0.92) [*]	0.75 (0.54, 1.05)
> 69 vs. <30	0.66 (0.38, 1.15)	0.78 (0.57, 1.05)	0.63 (0.36, 1.11)	0.78 (0.58, 1.06)
Region: rural vs. urban	0.59 (0.44, 0.79) [†]	0.57 (0.47, 0.70) [†]	0.87 (0.58, 1.3)	0.91 (0.67, 1.25)
Overseas experience last month	15.6 (2.51, 127.66) [†]	2.16 (0.68, 5.98)	14.66 (2.25, 95.41) [†]	1.74 (0.60, 5.07)
Education				
Medium vs. low	1.64 (1.13, 2.38) [†]	1.41 (1.09, 1.8) [†]	1.5 (1.05, 2.23) [*]	1.19 (0.92, 1.54)
High vs. low	1.13 (0.74, 1.71)	1.20 (0.95, 1.51)	1.07 (0.7, 1.62)	1.02 (0.80, 1.29)
Marriage: others vs. married	1.19 (0.84, 1.69)	1.50 (1.19, 1.88) [†]	1.13 (0.79, 1.62)	1.39 (1.10, 1.75) [†]
Employment: unemployed vs. employed	1.15 (0.81, 1.65)	1.13 (0.91, 1.39)	1.09 (0.76, 1.56)	0.97 (0.78, 1.21)
Quarantined: yes vs. no	0.24 (0.08, 0.58) [†]	0.81 (0.44, 1.40)	0.25 (0.09, 0.64) [†]	0.86 (0.48, 1.53)
Health				

*p < 0.05, [†]p < 0.01

	Univariate logistic model		Multivariate logistic model	
Good vs. low	0.35 (0.15, 0.88) *	0.43 (0.24, 0.79) †	0.36 (0.15, 0.88) *	0.46 (0.25, 0.82) †
Medium vs. low	0.42 (0.17, 1.07)	0.53 (0.29, 0.99) *	0.41 (0.16, 1.01)	0.50 (0.27, 0.94) *
Preference of imported or domestic vaccines				
Both fine vs. domestic	1.12 (0.80, 1.55)	1.48 (1.15, 1.9) †	1.09 (0.78, 1.52)	1.43 (1.11, 1.85) †
Imported vs. domestic	1.52 (0.92, 2.43)	1.6 (1.07, 2.34) *	1.5 (0.92, 2.43)	1.71 (1.15, 2.53) †
Unclear vs. domestic	7.52 (4.99, 11.37) †	9.65 (7.05, 13.29) †	7.68 (5.08, 11.61) †	10.22 (7.39, 14.13) †
Behavior	0.74 (0.61, 0.91) †	0.65 (0.57, 0.73) †	0.73 (0.60, 0.90) †	0.65 (0.57, 0.74) †
Attitude	0.14 (0.10, 0.19) †	0.10 (0.08, 0.13) †	0.14 (0.10, 0.20) †	0.10 (0.08, 0.13) †
*p < 0.05, †p < 0.01				

Figures

Figure 1

Timeline of the survey. The recruitment date from Jan 4, 2021 to April 12, 2021. The investigation was suspended for a period of time because of the sporadic outbreak in Shanghai, the Chinese New Year holidays and the implementation of quarantine policies during the Spring Festival travel rush.

Figure 2

Vaccine acceptance of the different people

Figure 3

sources of different vaccine information *TV means TV, radio, and newspapers, Internet included QQ, WeChat, Weibo, news websites, etc. propaganda means Community or the hospital propaganda

Figure 4

Reasons for not wanting to vaccinate

Figure 5

Acceptance under different scenarios. *have statistical significance compared with current scenario

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