Preplanned Studies

Willingness of the General Public to Receive the COVID-19 Vaccine During a Second-Level Alert — Beijing Municipality, China, May 2020

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Summary

What is already known on this topic?

Preclinical trials showed the effectiveness of domestic inactivated vaccine candidates for coronavirus disease 2019 (COVID-19). However, it is necessary to evaluate the willingness of the public to receive future domestic vaccines and to understand factors associated with willingness at the early stages of vaccine development.

What is added by this report?

Through May 25, 2020, 70.48% were willing to receive future domestic COVID-19 vaccines. Confidence in vaccines had the largest impact on public willingness, while age and presence of underlying chronic disease did not significantly increase public willingness.

What are the implications for public health practice?

It is necessary to increase awareness of COVID-19 vaccines among people with high risk of severe infection and to build public confidence in vaccines. Releasing accurate, timely, and reliable data to the public can help increase willingness to get vaccinated.

Preclinical animal studies showed that domestic inactivated vaccine candidates induced coronavirus disease 2019 (COVID-19) specific neutralizing antibodies, raising the possibility that mass vaccination with domestic vaccines might be used in the future to end the pandemic. This research conducted a survey among the public with a WeChat mini program (an application within WeChat) to determine intention to get vaccinated. Approximately 70.48% were willing to be vaccinated. Concerns about vaccine safety and effectiveness were the most important factors influencing willingness. Older age and presence of underlying chronic disease were not shown to significantly increase public willingness. Timely and accurate scientific data are greatly needed to build public confidence in vaccines, especially among people at high risk of severe COVID-19 infection. Immunization clinics may need increased resources to ensure high vaccination coverage.

On April 16, 2020, Beijing reported the city's first locally transmitted COVID-19 case. By April 30, 2020, Beijing reported no new cases for 14 consecutive days and lowered the COVID-19 emergency response from the highest level to the second highest level. As COVID-19 began spreading globally, Beijing faced an increasing risk of transmission of imported COVID-19 virus, also known as SARS-CoV-2. In May, 2020, domestic inactivated vaccines entered Phase Ⅱ clinical trials in healthy adults 18 years of age and older (*1*). Preclinical animal studies had shown that inactivated vaccines induced COVID-19-specific neutralizing antibodies in animals and had a protective effect with no observed antibody-dependent enhancement of infection (ADE) (*2*). The research conducted a survey between May 12, 2020 and May 25, 2020 to determine willingness of the general public to get a future COVID-19 vaccine.

The study was an exploratory cross-sectional survey in 2 urban districts and 3 rural districts of Beijing. Respondents were classified into 5 age groups: 18–30, 31–40, 41–50, 51–60, and >61 years old. We assumed an intention to get vaccinated (p) to be 50%, a maximum permissible error (δ) to be 10%, and an allowable α error of 5%. The estimated sample size for each age group was 385 according to the formula $n = \left(\frac{u_{\alpha}^{2} \times p \times (1-p)}{\delta^{2}} \right)$. The study surveyed at least 77 adults per age group in each district. We selected three townships with the largest population sizes. In each selected township, we selected the community with the largest population. Subjects were recruited by community committees. Two-dimensional barcodes were distributed to residential groups in WeChat, the mostly widely and frequently used mobile app for social communication in China (*3*). Respondents

scanned the barcodes and completed the questionnaire on WeChat. The survey was brief to help ensure response quality and completeness — it took subjects only two minutes to answer all questions, decreasing the survey abandonment rate. Each mobile phone could only be used once to answer questions. The number of respondents was tallied daily. The survey ended when the number of subjects in each age group and each district reached their targets.

The questionnaires were designed to obtain information on respondent willingness to be vaccinated with a future domestic COVID-19 vaccine, the most trusted sources of information, preferred vaccination venue, and demographics. Logic skip patterns and data completeness checks were set in WeChat. Study procedures were approved by the Institutional Review Board and Human Research Ethic Committee of Beijing Center for Disease Prevention and Control. Informed consent was obtained at the beginning of the survey. Intention to receive a future vaccine was the primary outcome of the survey, scored as "No", "Uncertain", or "Yes". Descriptive statistics was used to summarize results. Multinomial logistic regression was used to identify factors associated with intention to receive a future vaccine. The main outcome of "Yes" (willing) was used as the referent. Statistical analyses were conducted with SPSS software (version 18.0, SPSS Inc, Chicago, IL, USA).

A total of 3,208 adults were surveyed. More than 30% of respondents were not sure that domestic COVID-19 vaccines were safe and effective. Among all respondents, 70.48% (2,261/3,208) were willing to get vaccinated, 23.66% (759/3,208) were uncertain, and 5.86% (188/3.208) were not willing to get vaccinated. Willingness varied by demographics, perception of COVID-19 disease, and vaccine characteristics. Among people aged >60 years, 74.41% were willing to get vaccination. Among people with underlying chronic disease, 73.02% were willing to get vaccinated. The 3 factors associated with the highest rate of willingness (above 80%) were belief that vaccines were safe, belief that vaccines were effective, and whether they had received influenza vaccination during the most recent 3 years. Among people who thought vaccines were unsafe or ineffective, approximately 40% were unwilling to get vaccinated (Table 1).

TABLE 1. Demographic characteristics, perceptions of disease and domestic COVID-19 vaccines, and willingness to get a future vaccine in Beijing, China.

Variable	Number of interviewees (%)	Willingness to accept vaccination			*P* value*
		"No", n (%)	"Uncertain", n (%)	"Yes", n (%)	
Gender					
Female	1,950 (60.79)	111 (5.70)	500 (25.64)	1,339 (68.67)	0.004
Male	1,258 (39.21)	77 (6.12)	259 (20.59)	922 (73.29)	
Age (years)					
18–30	571 (17.80)	30 (5.25)	135 (23.64)	406 (71.10)	
31–40	1,050 (32.73)	56 (5.33)	284 (27.05)	710 (67.62)	
41–50	666 (20.76)	36 (5.41)	152 (22.82)	478 (71.77)	<0.001
51–60	456 (14.21)	34 (7.46)	101 (22.15)	321 (70.39)	
>60	465 (14.50)	32 (6.88)	87 (18.71)	346 (74.41)	
Highest education					
Secondary school or lower	474 (14.78)	25 (5.27)	94 (19.83)	355 (74.89)	
3-years of college	1,301 (40.55)	69 (5.30)	278 (21.37)	954 (73.33)	<0.001
Undergraduate or higher	1,433 (44.67)	94 (6.56)	387 (27.01)	952 (66.43)	
Living area					
Urban	1,821 (56.76)	97 (5.33)	491 (26.96)	1,233 (67.71)	<0.001
Suburban	1,387 (43.24)	91 (6.56)	268 (19.32)	1,028 (74.12)	
Income					
<5,000 CNY (700 USD)	1,526 (47.57)	92 (6.03)	337 (22.08)	1,097 (71.89)	0.134
≥5,000 CNY (700 USD)	1,682 (52.43)	96 (5.71)	422 (25.09)	1,164 (69.20)	

TABLE 1. (Continued)

Variable	Number of interviewees (%)	Willingness to accept vaccination			*P* value*
		"No", n (%)	"Uncertain", n (%)	"Yes", n (%)	
Underlying chronic disease					
Yes	430 (13.40)	37 (8.60)	79 (18.37)	314 (73.02)	0.002
No	2,778 (86.60)	151 (5.44)	680 (24.48)	1,947 (70.09)	
Seasonal flu vaccination within 3 years					
Yes	488 (15.21)	32 (8.44)	41 (10.82)	306 (80.74)	<0.001
No	2,720 (84.79)	156 (5.51)	718 (25.38)	1,955 (69.11)	
Perception of seriousness of COVID-19 disease					
Very serious	2,227 (69.42)	117 (5.25)	494 (22.18)	1,616 (72.56)	
Serious	869 (27.09)	55 (6.33)	234 (26.93)	580 (66.74)	<0.001
Not serious	112 (3.49)	16 (14.29)	31 (27.68)	65 (58.04)	
Perception of risk of contracting COVID-19					
Very likely	276 (8.60)	18 (6.52)	46 (16.67)	212 (76.81)	
Likely	1,467 (45.73)	73 (4.98)	355 (24.20)	1,039 (70.82)	0.020
Unlikely	1,465 (45.67)	97 (6.62)	358 (24.44)	1,010 (68.94)	
If infected, my symptoms would be more severe than other people's					
Yes	417 (13.00)	21 (5.04)	68 (16.31)	328 (78.66)	
Uncertain	1,847 (57.57)	74 (4.01)	484 (26.20)	1,289 (69.79)	<0.001
No	944 (29.43)	93 (9.85)	207 (21.93)	644 (68.22)	
Perception of impact of COVID-19 pandemic on own life within the past 3 months					
Very serious	835 (26.03)	112 (5.56)	437 (21.68)	1,467 (72.77)	
Serious	1,181 (36.81)	49 (5.08)	263 (27.28)	652 (67.63)	<0.001
Not serious	1,192 (37.16)	27 (11.84)	59 (25.88)	142 (62.28)	
Perception of impact of COVID-19 pandemic on own life in the next 6 months					
Very serious	390 (12.16)	86 (6.35)	295 (21.79)	973 (71.86)	
Serious	964 (30.05)	69 (4.72)	357 (24.42)	1,036 (70.86)	0.039
Not serious	1,854 (57.79)	33 (8.42)	107 (27.30)	252 (64.29)	
Perception of vaccine safety					
Safe	2,147 (66.93)	85 (3.96)	307 (14.30)	1,755 (81.74)	
Uncertain	1,028 (32.04)	87 (8.46)	444 (43.19)	497 (48.35)	<0.001
Unsafe	33 (1.03)	16 (48.48)	8 (24.24)	9 (27.27)	
Perception of vaccine effectiveness					
Effective	2,189 (68.24)	87 (3.97)	314 (14.34)	1,788 (81.68)	
Uncertain	1,000 (31.17)	93 (9.30)	440 (44.00)	467 (46.70)	<0.001
Ineffective	19 (0.59)	8 (42.11)	5 (26.32)	6 (31.58)	
Perception of rebound of COVID-19 infection in China					
Likely	632 (19.70)	63 (9.97)	121 (19.15)	448 (70.89)	
Uncertain	1,596 (49.75)	73 (4.57)	448 (28.07)	1,075 (67.36)	<0.001
Unlikely	980 (30.55)	52 (5.31)	190 (19.39)	738 (75.31)	
Perception of continuity of global COVID-19 transmission					
Likely	1,555 (48.47)	107 (6.88)	337 (21.67)	1,111 (71.45)	
Uncertain	1,195 (37.25)	50 (4.18)	327 (27.36)	818 (68.45)	<0.001
Unlikely	458 (14.28)	31 (6.77)	95 (20.74)	332 (72.49)	

*: χ^2 test.

Compared with the referent (willing) group, belief that vaccines were not safe was the most strongly associated factor for vaccine hesitancy and refusal, with adjusted odds ratio (OR) values of 2.86 and 13.33, respectively. People who had chronic diseases, who thought COVID-19 infection was not serious, who thought their symptoms would be less severe than others if infected, who thought their life had not been seriously affected during the previous three months, or who thought COVID-19 was likely to rebound in China, were more likely to refuse vaccines. Being uncertain of vaccine effectiveness was the second most associated factor for vaccine hesitancy, with an adjusted OR value of 2.68 (Table 2).

TABLE 2. Factors associated with intention to get a future domestic COVID-19 vaccine in Beijing, China.

Variable	Unwillingness*		Uncertainty*	
	Unadjusted OR (95%CI)	Adjusted OR (95%CI)	Unadjusted OR (95%CI)	Adjusted OR (95%CI)
Gender				
Female	1	1	1	1
Male	1.01 (0.74–1.36)	0.91 (0.65–1.26)	0.75 (0.63–0.89)	0.88 (0.72–1.06)
Age (years)				
18–30	1	–†	1	–†
31–40	1.07 (0.67–1.69)	–†	1.20 (0.95–1.53)	–†
41–50	1.02 (0.62–1.68)	–†	0.96 (0.73–1.25)	–†
51–60	1.43 (0.86–2.39)	–†	0.95 (0.70–1.27)	–†
>60	1.25 (0.75–2.10)	–†	1.20 (0.95–1.53)	–†
Highest education				
Secondary school or lower	1	1	1	1
3-years of college	1.03 (0.64–1.65)	1.54 (0.92–2.59)	1.10 (0.85–1.43)	1.06 (0.79–1.43)
Undergraduate or higher	1.40 (0.89–2.22)	1.26 (0.75–2.13)	1.54 (1.19–1.98)	1.39 (1.03–1.86)
Living area				
Urban	1	1	1	1
Suburban	1.13 (0.84–1.52)	1.28 (0.92–1.79)	0.66 (0.55–0.78)	0.79 (0.65–0.96)
Income				
<5,000 CNY (700 USD)	1	1	1	1
≥5,000 CNY (700 USD)	0.98 (0.73–1.32)	–†	1.18 (1.00–1.39)	–†
Underlying chronic disease				
Yes	1	1	1	1
No	0.66 (0.45–0.96)	0.50 (0.32–0.78)	1.39 (1.07–1.80)	1.17 (0.86–1.58)
Seasonal flu vaccination within 3 years				
Yes	1	1	1	1
No	0.76 (0.51–1.14)	0.69 (0.44–1.07)	2.74 (1.96–3.84)	2.28 (1.59–3.27)
Perception of seriousness of COVID-19 disease				
Very serious	1	1	1	1
Serious	1.31 (0.94–1.83)	1.25 (0.88–1.79)	1.32 (1.10–1.58)	1.33 (1.08–1.63)
Not serious	3.40 (1.91–6.06)	2.27 (1.18–4.37)	1.56 (1.01–2.42)	1.39 (0.86–2.27)
Perception of risk in contracting COVID-19				
Very likely	1	1	1	1
Likely	0.83 (0.48–1.42)	0.86 (0.48–1.56)	1.58 (1.12–2.21)	1.17 (0.80–1.70)
Unlikely	1.13 (0.67–1.91)	1.12 (0.61–2.07)	1.63 (1.16–2.30)	1.31 (0.89–1.93)
If infected, my symptoms would be more severe than other people's				
Yes	1	1	1	1

TABLE 2. (Continued)

Variable	Unwillingness*		Uncertainty*	
	Unadjusted OR (95%CI)	Adjusted OR (95%CI)	Unadjusted OR (95%CI)	Adjusted OR (95%CI)
Uncertain	0.90 (0.54–1.48)	1.22 (0.70–2.12)	1.81 (1.37–2.40)	1.38 (1.01–1.91)
No	2.26 (1.38–3.69)	3.05 (1.71–5.45)	1.55 (1.14–2.10)	1.23 (0.86–1.76)
Perception of impact of COVID-19 pandemic on own life within the past 3 months				
Very serious	1	1	1	1
Serious	0.98 (0.70–1.39)	1.16 (0.75–1.80)	1.35 (1.13–1.62)	1.28 (1.01–1.61)
not serious	2.49 (1.58–3.92)	2.54 (1.35–4.78)	1.40 (1.01–1.92)	1.17 (0.77–1.78)
Perception of impact of COVID-19 pandemic on own life in the next 6 months				
Very serious	1	1	1	1
Serious	0.75 (0.54–1.05)	0.77 (0.51–1.16)	1.14 (0.95–1.36)	1.07 (0.85–1.34)
Not serious	1.48 (0.97–2.27)	1.06 (0.58–1.95)	1.40 (1.08–1.82)	1.39 (0.97–1.97)
Perception of vaccine safety				
Safe	1	1	1	1
Uncertain	3.61 (2.64–4.95)	2.35 (1.44–3.83)	5.11 (4.28–6.09)	2.50 (1.91–3.27)
Unsafe	36.71 (15.77–85.47)	13.33 (4.83–36.80)	5.08 (1.95–13.27)	2.86 (1.02–7.96)
Perception of vaccine effectiveness				
Effective	1	1	1	1
Uncertain	4.09 (3.00–5.58)	2.52 (1.55–4.10)	5.37 (4.50–6.40)	2.68 (2.05–3.50)
Ineffective	27.40 (9.30–80.73)	3.52 (0.94–13.17)	4.75 (1.44–15.64)	3.28 (0.92–11.77)
Perception of rebound of COVID-19 infection in China				
Likely	1	1	1	1
Uncertain	0.48 (0.34–0.69)	0.57 (0.37–0.89)	1.54 (1.23–1.94)	1.23 (0.93–1.62)
Unlikely	0.50 (0.34–0.74)	0.56 (0.35–0.92)	0.95 (0.74–1.23)	1.08 (0.79–1.48)
Perception of continuity of global COVID-19 transmission				
Likely	1	1	1	1
Uncertain	0.64 (0.45–0.90)	0.63 (0.41–0.97)	1.32 (1.10–1.57)	0.96 (0.77–1.20)
Unlikely	0.97 (0.64–1.47)	1.16 (0.70–1.92)	0.94 (0.73–1.22)	1.12 (0.83–1.52)

*: Being willing to get vaccine was selected as reference category in multinomial logistic regression.
†: Variables that were not statistically significant in univariate analyses were excluded from the multinomial logistic regression model.

Respondents' most popular sources of information about COVID-19 vaccines were social media (86.94%, 2,789/3,208), medical doctors (78.68%, 2,524/3,208), and professional papers (34.57%, 1,109/3,208). Among the 2,261 respondents who were willing to get vaccinated, 58.29% (1,318/2,261) preferred getting vaccinated in immunization clinics.

DISCUSSION

This study found that 70% of the general public were willing to be vaccinated with a COVID-19 vaccine, a rate close to the 74% willingness found in a study conducted in France at about the same time as our survey (*4*). A study in Wuhan city showed that the basic reproduction number (R_0) of COVID-19 was 2.24–3.58 (*5*) in the early phase of the epidemic, indicating that 55.36%–72.07% of the population needs to be immune to the virus to prevent sustained transmission. Based on that result, the future COVID-19 vaccination rate should be at least 70% in Beijing, assuming that COVID-19 vaccines are 70%–80% effective in preventing disease. In our study, about 70% were willing to get COVID-19 vaccines, which is close to that target. We also found that 20% of the general public was uncertain whether they would get a COVID-19 vaccine. Among people who believed vaccines were safe and effective, 81% were willing to get vaccinated. Therefore, achieving the goal of no sustained spread of COVID-19 seems not far off in Beijing through use of a mass vaccination program. In

January 2021, Beijing started a COVID-19 vaccination campaign targeting people aged 18–59 years old, and shortly thereafter extended the age range to 60 years and above. At the time of publication of this article, coverage of the 1st dose of COVID-19 vaccine has exceeded the 70% coverage level that was predicted in our study, as more than 80% of people over 18 years of age have already received at least one dose of COVID-19 vaccine in the ongoing campaign (*6*).

Among interviewees, more than 30% were not confident in COVID-19 vaccines — a finding that may be due to lack of scientific data at the time the survey was conducted. "Vaccine hesitancy" (*7*) could be another reason. Our multivariable analyses showed confidence in vaccine safety had the highest impact on public willingness. Although belief that the vaccine was ineffective did not significantly increase the unwillingness rate, the OR value was 27.40, and statistically significant in univariate analyses. Being uncertain of vaccine effectiveness was also significantly associated with vaccine hesitancy (Table 2). Therefore, building confidence in domestic vaccines should be a priority. It was noteworthy that age had no significant impact on willingness. It is therefore important to increase awareness of vaccines among people ≥60 years of age, who were more likely to have severe COVID-19 (*8*). People who thought COVID-19 was serious or who thought their symptoms would be more severe than others if infected, were more willing to get vaccinated. This finding implies that social mobilization, especially among people with high risk of severe COVID-19, could increase vaccine acceptance. If vaccines are shown to be effective against severe infection, willingness to get vaccines may significantly increase. Presence of underlying chronic diseases was associated with an increased possibility to refuse vaccination. That could be due to concerns that vaccination may exacerbate the disease. It is difficult to explain our finding that people who believed COVID-19 might rebound in China were more likely to refuse vaccination. Further study on this point is needed. The finding does suggest that social mobilization is necessary among people believing that COVID-19 will rebound in China.

More than 70% of the general public received vaccine information from social media or medical doctors. Media reports therefore should be objective and fair. Increased willingness of medical doctors to get vaccinated could be another key factor. Around one third of the public received information from professional literature. Hence, accurate, timely, and reliable data about vaccines should be released to the general public through social media and medical doctors.

Over half of respondents preferred getting vaccinated in clinics that provide routine immunization for children aged 0–14 years. Increased resources and personnel for immunization clinics would be necessary to avoid decreases in coverage of routine vaccines during mass COVID-19 vaccination.

Social mobilization has played an important role in achieving high coverage in Beijing's vaccination campaign. Consistent with findings in our study, building public confidence in vaccines through publicity of the COVID-19 vaccine clinical trials that showed the vaccines to be safe and effective, making vaccination convenient by establishing temporary vaccination clinics, and using social media to increase awareness of the importance of immunization have been instrumental in building high coverage levels.

Our study has some limitations. First, our result could not be generalized to the entire adult population. Second, our results can only be applied to when Beijing set its public health emergency response to the second level and data of Phase I clinical trials of domestic COVID-19 vaccines were available. Continued monitoring will be important. Third, self-reported data may have introduced information bias.

Our study showed a high level of willingness of the general public to be vaccinated with domestic COVID-19 vaccines. Building public confidence in vaccines through social media and medical doctors is needed. It is also necessary to increase awareness of vaccines among people with high risk of severe COVID-19 infections. Increased personnel and resources for routine immunization clinics should be considered to prepare for mass vaccination efforts.

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