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RESEARCH PAPER

Willingness of the general population to accept and pay for COVID-19 vaccination during the early stages of COVID-19 pandemic: a nationally representative survey in mainland China

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ABSTRACT

The COVID-19 pandemic has caused negative impacts both on populations' health worldwide. COVID-19 vaccines are currently developed and tested in clinical trials. However, limited studies have investigated the willingness to get COVID-19 vaccines in populations. Therefore, the study aimed to determine the individual's willingness to accept and pay for COVID-19 vaccines, and knowledge, attitude, and perceptions (KAP) of COVID-19 vaccines, which hopefully will be available soon. Non-pregnant Chinese adults aged ≥18 years were asked to complete a self-administered KAP COVID-19 vaccine questionnaire distributed between March and May 2020. A total of 1179 participants (574 males and 605 females) were included and the mean age was 36.0 ± 11.5 years. Both the willingness to be vaccinated against COVID-19 and pay for COVID-19 vaccines were high (77.4% and 81.1%), respectively. Also, the most acceptable price range of COVID-19 vaccine was ¥501-1000 (US $ 75–149). Education and willingness to be vaccinated were significantly associated with some of the responses in KAP ($P < .05$). In conclusion, our study reported high willingness to be vaccinated against COVID-19 and pay for COVID-19 vaccines in Chinese population. Our findings also provided some important contributions for public health policy makers to formulate appropriate vaccination programs.

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Introduction

COVID-19 pandemic is a global threat. A systematic review and meta-analysis of 30 studies (n = 53,000 COVID-19 patients) by Zhao et al. reported that the mortality was 3.1%.[1] In addition, the COVID-19 mortality increased significantly in the elderly and individuals with comorbidities including chronic disease and cardiovascular disease (CVD).[2] Currently, there are no specific drug therapies approved by the US Food and Drug Administration (FDA) for COVID-19 patients.[3] Therefore, the COVID-19 vaccines are considered one of the most promising strategies to combat COVID-19 pandemic.

Immunization is one of the important public health measures to protect individuals from contracting serious infectious diseases.[4] Especially when dealing with the coronavirus diseases 2019 (COVID-19) pandemic, the development and deployment of COVID-19 vaccines is crucial in limiting the spread of the COVID-19 pandemic before the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) acquired increased antiviral resistance.[5] However, high vaccination coverage is needed to stop the spread of the COVID-19 pandemic. Although some studies have been conducted to explore the vaccines against some emerging infectious diseases including Zika, Ebola, and dengue,[6–8] there are limited studies that have been conducted to assess the acceptance of COVID-19 vaccines.[3,9] The results of such studies are very important for the health authorities to formulate the best suitable approach to implement COVID-19 vaccination programme, especially in developing countries.

In China, some vaccine uptakes including influenza vaccines have been reported to be lower (25%) than those of developed countries including United Kingdom (50%), Spain (51%), and the United States of America (USA) (79%).[10–13] Therefore, the study aimed to determine the individual's willingness to accept and pay for COVID-19 vaccines, which are hopefully to be available soon. In addition, the knowledge, attitude, and perceptions (KAP) about COVID-19 vaccines amidst the COVID-19 pandemic were also investigated in Chinese population.

Methods

A cross-sectional study was conducted in China between March 2020 and May 2020 using mixed sampling process (i.e., convenience and snowball samplings). The target population was non-pregnant Chinese adults aged ≥18 years who were willing to provide informed consent for participating in the study. The study procedure were approved by the Ethics Committee of the Jinzhou Medical University, and performed following The Code of Ethics of the World Medical Association (Declaration of Helsinki) and CHERRIES statement.[14]

KAP regarding COVID-19 vaccines

Participants were asked to report their responses in a validated modified KAP COVID-19 vaccine questionnaire on a 5-point

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Likert scale.[9,15–19] Questions included were: "how contagious is SARS-CoV-2?", "can the COVID-19 vaccine cause COVID-19?", "do you think you are at risk to get COVID-19?", "all adults should get vaccinated against COVID-19", and "the COVID-19 vaccine is safe and effective in preventing COVID-19". In addition, participants were asked to complete questions regarding their attitudes and perceptions toward COVID-19 vaccination. These questions included "immunizations do more good than harm", "trust immunizations that have been around for a while", "immunisation protects vulnerable individuals from getting diseases from unimmunized individuals", immunization requirements went against freedom of choice", "immunizations get safer and better all of the time", "perceived severity of COVID-19 effect to own life", and "perceived risk of getting COVID-19".

Participants were inquired if they would accept or refuse COVID-19 vaccines when these vaccines would be available soon with their reasons. Also, questions based on a 5-point Likert scale such as willingness to pay for COVID-19 vaccines were included in the questionnaire.

Sources of vaccine information

Participants were first asked to indicate how they usually received the vaccine information, followed by an evaluation of the quality of the main sources of vaccine information listed in the questionnaire.[18] For example, family members, friends, Internet (reliable websites such as the World Health Organization), visits to healthcare providers, mass media, alternative healthcare providers, vaccine industry and companies, and printed materials from healthcare providers. The response options for these questions ranged from 1 (very poor quality) to 5 (excellent quality).[18]

Statistical analysis

All the statistical analyses were conducted using SPSS ver. 24.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to present sociodemographic data including age. Participant responses were calculated and reported as the percentages of cases. Analyses of covariance (ANCOVA) and Chi-square tests were used to compare differences between continuous and categorical data, respectively. Multiple logistic regression analyses were conducted to determine the factors potentially associated with the willingness to accept COVID-19 vaccines. The level of statistical significance was set to $P < .05$.

Results

Participant characteristics

Of the 2300 adults who responded to the survey, 48.7% reported that they were not interested (including: no time to complete the survey and the length of the survey was too long); therefore, only 1179 (51.3%) valid responses were retained in the final data analysis (Table 1). The mean age of participants was 36.0 ± 11.5 years and both sexes had a similar mean age ($P = .386$). Majority of participants were married (81.1%), from high-risk regions (96.0%), did not have any religious beliefs (96.6%) and had earned a higher educational level (86.8%) at the time of study. Only 7.0% and 21.5% of participants worked as healthcare workers and had chronic diseases. More than half of participants reported no perceived increased risk of contracting COVID-19 (53.7%) and severity of effect of COVID-19 to own life (52.1%). Only 1.0% of participants were previously diagnosed with COVID-19.

Majority of participants reported that they would be willing to be vaccinated against COVID-19 (77.4%) and pay for a COVID-19 vaccine (81.1%) (Table 1). Reasons provided for the willingness to be vaccinated against COVID-19 were because of the recommendations from health authorities (25.5%), followed by "protective" (27.7%), "safe" (27.3%), "effectiveness" (16.1%), and "affordable" (3.4%). On the other hand, reasons provided for not willing to be vaccinated against COVID-19 were "concerned about vaccine side effects" (52.2%), "vaccines not safe (39.3%), "afraid of injections"

Table 1. Sociodemographic characteristics of participants.

Variables	Total (n = 1179)	Males (n = 574)	Females (n = 605)	P-value
Age (years)	36.0 ± 11.5	36.3 ± 11.5	35.7 ± 11.4	.386
Marital status, n (%)				
Single/Divorced	223 (18.9)	116 (20.2)	107 (17.7)	.298
Married	956 (81.1)	458 (79.8)	498 (82.3)	
Education level, n (%)				
Secondary school	156 (13.2)	82 (14.3)	74 (12.2)	.304
Higher qualification	1023 (86.8)	492 (85.7)	531 (87.8)	
Religion, n (%)				
No	1139 (96.6)	559 (97.4)	580 (95.9)	.197
Yes	40 (3.4)	15 (2.6)	25 (4.1)	
Healthcare worker, n (%)				
Yes	83 (7.0)	44 (7.7)	39 (6.4)	.427
No	1096 (93.0)	530 (92.3)	566 (93.6)	
High-risk regions, n (%)				
Yes	47 (4.0)	26 (4.5)	21 (3.5)	.375
No	1132 (96.0)	548 (95.5)	584 (96.5)	
Presence of chronic diseases, n (%)				
Yes	253 (21.5)	132 (23.0)	121 (20.0)	.228
No	926 (78.5)	442 (77.0)	484 (80.0)	
Diagnosed with COVID-19, n (%)				
Yes	12 (1.0)	9 (1.6)	3 (0.5)	.084
No	1167 (99.0)	565 (98.4)	602 (99.5)	
Perceived increased risk of contracting COVID-19, n (%)				
Yes	546 (46.3)	269 (46.9)	277 (45.8)	.726
No	633 (53.7)	305 (53.1)	328 (54.2)	
Perceived increased severity of effect of COVID-19 to own life, n (%)				
Yes	565 (47.9)	274 (47.7)	291 (48.1)	.907
No	614 (52.1)	300 (52.3)	314 (51.9)	
Willingness to be vaccinated against COVID-19, n (%)				
Yes	912 (77.4)	448 (78.0)	464 (76.7)	.626
No	267 (22.6)	126 (22.0)	141 (23.3)	
Willing to pay for a COVID-19 vaccine, n (%)				
Yes	956 (81.1)	476 (82.9)	480 (79.3)	.119
No	223 (18.9)	98 (17.1)	124 (20.7)	
Acceptable price (¥, in Chinese currency, Renminbi (RMB)) for a COVID-19 vaccine, n (%)				
<500 (<US $ 75)	287 (24.3)	140 (24.4)	147 (24.3)	.790
501–1000 (US $ 75–149)	435 (36.9)	219 (38.2)	216 (35.7)	
1001–1500 (US $ 150–224)	328 (27.8)	153 (26.7)	175 (28.9)	
>1500 (>US $ 224)	129 (10.9)	62 (10.8)	67 (10.1)	

(5.9%), and "prefer to natural and traditional remedies (2.6%). Also, majority of participants reported the acceptable price range of COVID-19 vaccine ranging from ¥501-1000 (US 75–149 USD) (36.9%), followed by ¥1001-1500 (US 150–224 USD) (27.8%), <¥500 (<US 75 USD) (24.3%), and >¥1500 (>US 224 USD) (10.9%).

Knowledge, attitude and perceptions (KAP) regarding vaccination

Overall, more than half of participants (73.8%) disagreed that a COVID-19 vaccine can cause SARS-CoV-2 infection (Table 2). Education level was significantly associated with the response for the statement"COVID-19 vaccine can cause SARS-CoV-2 infection" ($P < .001$). In addition, majority of participants (76.3%) agreed that COVID-19 vaccine is safe and effective for preventing COVID-19. Although majority of participants (69.3%) agreed that they were at risk of getting COVID-19, only half of participants (50.0%) agreed that all adults should get vaccinated against COVID-19. The willingness to be vaccinated against COVID-19 was significantly associated with the positive response that all adults should be vaccinated against COVID-19 ($P = .002$) and they were at risk of getting COVID-19 ($P = .013$).

In addition, majority of participants reported that COVID-19 was very contagious (81.2%), followed by "somewhat contagious" (12.4%), and "minimally contagious" (6.4%). More than half of participants agreed that everyone could potentially spread COVID-19 to others (77.8%), trusted the immunizations that had been around for a while (60.3%), immunizations were better and safer all the time (67.5%) and immunizations did more good than harm (70.1%). Education level was significantly associated with the response for the statements "immunizations were better and safer all the time" ($P = .004$) and "immunizations did more good than harm" ($P < .001$).

More than half of participants (67.6%) did not oppose to immunizations. In addition, majority of participants agreed that immunization protected immunized adults from getting diseases from unimmunized adults (74.2%). The willingness to be vaccinated against COVID-19 was significantly associated with the positive response that immunization protected immunized adults from getting diseases from unimmunized adults ($P = .007$).

COVID-19 vaccine information sources

Overall, majority of participants (32.7%) reported using media to obtain COVID-19 vaccine information, followed by Internet (19.8%), visits to healthcare providers (15.4%), family members

Table 2. Knowledge, attitudes and perceptions (KAP) regarding vaccination among participants.

	Sex (n = 1179)			Willingness to be vaccinated against COVID-19 (n = 1179)			Education level (n = 1179)		
	Males (n = 574)	Females (n = 605)	P-value	Yes (n = 912)	No (n = 267)	P-value	Secondary level (n = 156)	Higher qualification (n = 1023)	P-value
COVID-19 vaccine can cause SARS-CoV-2 infection, n (%)									
Yes	156 (27.2)	147 (24.3)	0.286	230 (25.2)	73 (27.3)	0.524	21 (13.5)	282 (27.6)	**<.001**
No	418 (72.8)	458 (75.7)		682 (74.8)	194 (72.7)		135 (86.5)	741 (72.4)	
COVID-19 vaccine is safe and effective in preventing COVID-19, n (%)									
Yes	437 (76.1)	462 (76.4)	0.945	693 (76.0)	206 (77.2)	0.774	115 (73.7)	784 (76.6)	.420
No	137 (23.9)	143 (23.6)		219 (24.0)	61 (22.8)		41 (26.3)	239 (23.4)	
All adults should receive COVID-19 vaccine, n (%)									
Yes	279 (48.6)	311 (51.4)	0.351	479 (52.5)	111 (41.6)	**0.002**	74 (47.4)	516 (50.4)	.493
No	295 (51.4)	294 (48.6)		433 (47.5)	156 (58.4)		82 (52.6)	507 (49.6)	
I feel that I am at risk to get COVID-19, n (%)									
Yes	400 (69.7)	417 (68.9)	0.801	649 (71.2)	168 (62.9)	**0.013**	104 (66.7)	713 (69.7)	.457
No	174 (30.3)	188 (31.1)		263 (28.8)	99 (37.1)		52 (33.3)	310 (30.3)	
Everyone can potentially spread SARS-CoV-2 to other people, n (%)									
Yes	449 (78.2)	468 (77.4)	0.727	707 (77.5)	201 (22.9)	0.738	122 (78.2)	795 (77.7)	.890
No	125 (21.8)	137 (22.6)		205 (22.5)	57 (21.3)		34 (21.8)	228 (22.3)	
SARS-CoV-2 is contagious, n (%)									
Minimally	41 (7.1)	35 (5.8)	0.324	58 (6.4)	18 (6.7)	0.560	11 (7.1)	65 (6.4)	.667
Somewhat	64 (11.1)	82 (13.6)		118 (12.9)	28 (10.5)		16 (10.3)	130 (12.7)	
Very	469 (81.7)	488 (80.7)		736 (80.7)	221 (82.8)		129 (82.7)	828 (80.9)	
More likely to trust immunizations that have been around for a while, n (%)									
Yes	353 (61.5)	358 (59.2)	0.439	547 (60.0)	164 (61.4)	0.722	103 (66.0)	608 (59.4)	.135
No	221 (38.5)	247 (40.8)		356 (40.0)	103 (38.6)		53 (34.0)	415 (40.6)	
Immunizations are getting better and safer all of the time, as a result of medical research, n (%)									
Yes	388 (67.6)	408 (67.4)	0.954	608 (66.7)	188 (70.4)	0.266	121 (77.6)	675 (66.0)	**.004**
No	186 (32.4)	197 (32.6)		304 (33.3)	79 (29.6)		35 (22.4)	348 (34.0)	
Immunizations do more good than harm, n (%)									
Yes	401 (69.9)	426 (70.4)	0.849	637 (69.8)	190 (71.2)	0.704	130 (83.3)	697 (68.1)	**<.001**
No	173 (30.1)	179 (29.6)		275 (30.2)	77 (28.8)		26 (16.7)	326 (31.9)	
Opposed to immunization requirements because they go against freedom of choice, n (%)									
Yes	192 (33.4)	190 (31.4)	0.456	294 (32.2)	88 (33.0)	0.824	44 (28.2)	338 (33.0)	0.270
No	382 (66.6)	415 (68.6)		618 (67.8)	179 (67.0)		112 (71.8)	685 (67.0)	
Immunization requirements protect immunized adults from getting diseases from unimmunized adults, n (%)									
Yes	430 (74.9)	445 (73.6)	0.641	660 (72.4)	215 (80.5)	**0.007**	121 (77.6)	754 (73.7)	0.327
No	144 (25.1)	160 (26.4)		252 (27.6)	52 (19.5)		35 (22.4)	269 (26.3)	

Table 3. Perceptions of SARS-CoV-2 vaccine information sources among participants.

	Sex (n = 1179)			Willingness to be vaccinated against COVID-19 (n = 1179)			Education level (n = 1179)		
Information source	Males (n = 574)	Females (n = 605)	P-value	Yes (n = 912)	No (n = 267)	P-value	Secondary level (n = 156)	Higher qualification (n = 1023)	P-value
Good/excellent source									
Internet, n (%)	519 (90.4)	552 (91.2)	0.686	828 (90.8)	243 (91.0)	0.912	139 (89.1)	932 (91.1)	.455
Media, n (%)	515 (89.7)	521 (86.1)	0.061	822 (90.1)	214 (80.1)	**<0.001**	131 (84.0)	905 (88.5)	.115
Visits to healthcare providers, n (%)	543 (94.6)	568 (93.9)	0.619	874 (95.8)	237 (88.8)	**<0.001**	151 (96.8)	960 (93.8)	.194
Printed materials from healthcare providers, n (%)	516 (89.9)	552 (91.2)	0.485	839 (92.0)	229 (85.8)	0.004	147 (94.2)	921 (90.0)	.106
Alternative healthcare providers, n (%)	534 (93.0)	562 (92.9)	0.926	853 (93.5)	243 (91.0)	0.173	145 (92.9)	951 (93.0)	.995
Vaccine companies and industry, n (%)	169 (29.4)	171 (28.3)	0.700	247 (27.1)	93 (34.8)	**0.017**	48 (30.8)	292 (28.5)	.570
Family members, n (%)	540 (94.1)	576 (95.2)	0.438	867 (95.1)	249 (93.3)	0.278	145 (92.9)	971 (94.9)	.337
Friends, n (%)	537 (93.6)	578 (95.5)	0.157	861 (94.4)	254 (95.1)	0.759	148 (94.9)	967 (94.5)	.859

(12.1%), friends (8.3%), printed materials from healthcare providers (6.2%), alternative healthcare providers (3.6%), and vaccine companies and industry (1.9%) (Table 3). Factors including the willingness to be vaccinated against COVID-19 vaccine and education level were significantly associated with the types of COVID-19 vaccine information sources ($P < .05$).

More than 85.0% of participants rated all COVID-19 vaccine information sources as good/excellent sources except for vaccine companies and industry (28.8%). No differences in perceptions of COVID-19 vaccine information sources were reported for sex and education level (all $P > .05$). There were no differences in perceptions of COVID-19 vaccine information sources for the willingness to be vaccinated against COVID-19 except media ($P < .001$), visits to healthcare providers ($P < .001$), and vaccine companies and industry ($P = .017$).

Discussion

As of October 2020, the COVID-19 virus SARS-CoV-2 has infected tens of millions of people worldwide, resulting in more than one million deaths.[20] The COVID-19 pandemic has negatively impacted on the quality of life and health of the populations including pregnant women.[21–23] Hence, clinical research laboratories and research institutions are working to develop a COVID-19 vaccine which is important to reduce the mortality and health costs associated with the COVID-19 treatment. However, it is unclear how much the general population would value the COVID-19 vaccine and understand the KAP regarding COVID-19 vaccination. This is because in order to achieve herd immunity, it is important to have higher vaccination rate.[24] Our study was therefore designed to assess these research questions regarding COVID-19 vaccination in a sample of Chinese population when the COVID-19 vaccines are available.

Currently, there have been at least 137 vaccine candidates in preclinical phases and 23 candidates in clinical evaluation phases.[25] Effective and safe COVID-19 vaccines will be expected to play a leading role in curbing the transmission of COVID-19. The development of any vaccines including COVID-19 vaccines is costly and lengthy.[25] In our study, majority of participants reported that the acceptable price range of COVID-19 vaccine should be ranging from ¥501-1000. In addition, our study reported that 81.1% of participants were willing to pay for a COVID-19 vaccine. Our findings were consistent with the findings by Garcia and Cerda.[26] The authors reported that 90.6% of the Chilean adults (n = 566) would be willing to pay for a COVID-19 vaccine.[26] However, it is important to ensure that COVID-19 vaccines are made affordable, especially to some population groups with lower socioeconomic status. Therefore, price control can be one of the approaches to ensure that effective COVID-19 vaccines are widely affordable to all different population groups.[27]

Our study reported that 77.4% of participants were willing to be vaccinated against COVID-19, which was higher than the percentage of participants who were willing to be vaccinated against COVID-19 according to a European survey by Neumann-Böhme (73.9%). In addition, the major reason why our participants were willing to be vaccinated against COVID-19 was because of the recommendations from health authorities. On the other hand, the major reason why participants were unwilling to be vaccinated against COVID-19 was because they were concerned about vaccine side effects. Therefore, it is imperative to highlight and emphasize the benefits of COVID-19 vaccination, which can reflect on strengthening trust in COVID-19 vaccines among the population. In addition, it is important to note that the avoidance of COVID-19 vaccination can lead to a lower COVID-19 vaccination rate among the population and increase the risk of SARS-CoV-2 infection. Therefore, in order to further improve the vaccination rate, the relevant health authorities need to design and develop health education programs emphasizing the importance of vaccination.

Despite of high willingness of participants to be vaccinated against COVID-19, majority of participants in our study reported no perceived increased severity of effect of COVID-19 to own life and risk of contracting COVID-19. Several studies reported that high-perceived risk for contracting an infection was associated with increased vaccine acceptance in populations.[28–30] In addition, a study by Harapan et al. reported that a higher perceived risk to be infected with COVID-19 was associated with higher willingness to be vaccinated against COVID-19 in a sample of Indonesian adults.[3] Therefore, the relationships between perceived risk and vaccine acceptance may be complicated.[3] In our study, although more than half of our participants did not have perceived increased risk, they still would want to obtain COVID-19

vaccines. Therefore, future studies should investigate the potential factors including the effectiveness of COVID-19 vaccines and compliance with social distancing measures associated with COVID-19 vaccine acceptance in populations.

In addition, majority of participants in our study reported using media and Internet to obtain COVID-19 vaccine information. Online sources have been reported to be one of the important sites for individuals to seek for health-related information especially in the 21st century. Therefore, online sources can be one of the important factors that can influence health behaviors and attitudes in individuals. On the other hand, if these online resources contain some misinformation details that may negatively influence health behaviors and attitudes, this can cause some adverse effects on the individual health status. For example, majority of individuals received vaccination information via online sources which have become the primary source of information.[31] Future studies should include the components of health literacy or eHealth literacy for COVID-19 vaccination survey.

Several strengths in our study included a larger sample of Chinese adults. In addition, to our knowledge, our study was one of the first studies to lead the characterization of willingness to accept and pay for COVID-19 vaccines, and KAP regarding COVID-19 vaccines among the general population in China. Nevertheless, our study had limitations which were needed to be addressed. For example, the sampling techniques used in our study might have left out some under-representation of vulnerable communities including elderly and individuals with lower sociodemographic characteristics. In addition, our study only assessed the COVID-19 acceptance using a questionnaire, which may differ from the preferences of participants in real-life situation when the COVID-19 vaccines are available. Future studies should also consider investigating if there are differences in the COVID-19 vaccination rate between different provinces, regions (e.g. urban vs. rural) and population groups (e.g. pregnant women and elderly). In addition, future studies should consider investigating the COVID-19 vaccination rate in refugees and migrants from war zones.[32]

In conclusion, our study reported high willingness to be vaccinated against COVID-19 and pay for COVID-19 vaccines in Chinese population. The COVID-19 pandemic has presented several significant challenges including the willingness to be vaccinated against COVID-19 vaccines. Hopefully, the unprecedented outbreak would concede momentum and room for the health authorities to address these critical issues from a global perspective, especially in vulnerable populations.

Disclosure of potential conflicts of interest

No potential conflicts of interest were disclosed.

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Author contributions

Conceptualization, Yutong Zhang and Zheng Feei Ma; Formal analysis, Yutong Zhang, Xiaoqin Luo, and Zheng Feei Ma; Methodology, Yutong Zhang and Zheng Feei Ma; Writing – original draft, Yutong Zhang; Writing – review & editing, Yutong Zhang, Xiaoqin Luo, and Zheng Feei Ma.

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