Knowledge, Perception, and Acceptability on Covid-19 Vaccine Among International Students: A Cross-section Study in China

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Abstract

Background: International students could experience an uncomfortable vaccination approach when studying in a foreign country due to awareness issues. This study aimed to assess the knowledge, perception, and acceptability of the COVID-19 vaccine among international students in Lanzhou, China.

Methodology: A cross-sectional study was carried out from April to June 2021. The questionnaire comprised of questions on knowledge, perception, and acceptability about the COVID-19 vaccine was developed using Google form. The link was shared with the participants via WhatsApp and WeChat. Descriptive statistics were performed to describe participant characteristics. The Chi-square test was applied to assess the association level among variables with a significance level of P<0.05.

Results: 462 participants responded in this study, 312 (67.5%) and 150 (32.5%) were male and female, respectively. Females compared to male participants were correctly answered questions related to the vaccination and allergic reactions 63.3% vs. 48.4%, while males compared to females had good knowledge on a question related to community (herd) immunity 49.7% vs. 33.3%. Females had a substantially greater perception of the COVID-19 vaccinations than males, 46 % vs. 39.4 %. The respondents who planned to be vaccinated if a COVID-19 vaccine was available were only 22.7%.

Conclusion: Even though participants' knowledge about the COVID-19 was not scarce, most of the respondents were not prepared to get vaccinated. However, the interference of their beliefs can be a barrier. Therefore, it is recommended to provide unique campaigns in different universities with international students to overcome wrong myths about the COVID-19vaccine.

1. Introduction Hundreds of millions of people worldwide were infected by Coronavirus disease in 2019 (COVID-19) before it became a pandemic (1). Thus, the World Health Organization proclaimed COVID-19 as a pandemic on March 11, 2020 (2). It induced almost one million deaths, primarily among the higher-risk group, which included obese individuals, smokers, and patients (3). COVID-19 has a major economic impact in addition to its health benefits, which should not be neglected (4). Even though some drugs have been employed to treat severe COVID-19 patients, vaccination is the best hope for a long-term solution to the pandemic's eradication (5,6). This vaccine development was fast, and the number of COVID-19 vaccine candidates was more than 100, being developed on April 8, 2020 (7). The contest for COVID19 vaccine development to fight the disease's spread and disastrous consequences is ongoing worldwide (8). Furthermore, misconceptions, rumors, and misrepresentations might spread easily online, particularly using social media (9). In general, knowledge of some populations, perceptions, and acceptability towards the COVID-19 vaccine is poorly understood (10). Vaccine hesitancy due to a lack of awareness, negative perceptions, and ethical and safety concerns may pose severe challenges to achieving coverage for population immunity. Therefore, this cross-section study investigates the knowledge, perceptions, and acceptability among international students in China. This study's implementation will help us identify the actual situation about knowledge, perceptions, and acceptability of the COVID-19 vaccine among the international student community in China. The findings will propose measures to change during the vaccination activities program. It will also contribute to developing evidence-based policy and strategies for implementing the vaccination methods in the community. Through the school of public health and other researchers, Lanzhou university can also use the results of this study as baseline information for further research related to the COVID-19 vaccine.

2. Methodology

2.2. *Study area and target population*

This study is based in the People's Republic of China, positioned in East Asia with around 9.6 million square kilometers. It is the world's most populous country, with a population size of around 1.4 billion. A Statistical Report on Foreign Students in China for 2018 published by the Ministry of Education PR-China states that 492,185 international students are undertaking their studies in China's universities. In 2019, international students in China increased by 0.62% compared to 2017 (11).

2.3. *Study design*

This research was conducted as a descriptive, cross-sectional study. The online survey was used from April to June 2021 because it was strongly recommended that social distancing methods be used as one of the measures to combat the spread of COVID-19.

2.4. *Sample size*

The target of the total study sample was 400 respondents. The sample size was obtained using Yamane's formula, as shown below:

$$n = \frac{x}{1 + xe^2}$$

Where **n, x,** and **e** represent the sample size, population size, and sampling error, respectively. If x= 492185 international students, **e=** 0.05 then, Sample size= 400 Participants.

Inclusion and exclusion criteria:

International students in China aged 18 years old and above, who voluntarily accepted to participate in the study without any medical condition that may interfere with an exact answer, and also those who have received the COVID-19 vaccine, were included. The study excluded people aged below 18 years old.

2.5. *Data collection and procedures*
The survey was conducted through an online questionnaire, which included informed consent and four components (i.e., socio-demographics, knowledge, perceptions, and acceptability). A semi-structured questionnaire was created via a Google form. The link was created and widely distributed on many social media platforms (e.g., WeChat, WhatsApp, etc.). For data collection, to reserve social distance and necessary precautions during the epidemic, the authors chose an online strategy rather than face-to-face for collecting data.

2.6. *Ethical consideration*
This study was approved by the School of Public Health's Research Ethics Committee and permitted the authors to perform it. The information of participants, as well as the recorded replies, were kept secret and anonymous.

2.7. *Data analysis*
Data were entered, edited, sorted, and coded in Microsoft Excel 2019 before being imported into SPSS software (version 22.0) for analysis. Chi-square tests and descriptive statistics (i.e., frequencies, percentages, and means) were used. To find a significant relationship between average knowledge and perception scores and sociodemographic data, a t-test or one-way analysis of variance was used. Finally, binary linear regression analysis is used to include components that are significantly related to knowledge and perception scores. At a 95% confidence interval and a p-value <0.05, the statistical tests were regarded as significant

3. Results
Participants' information was comprised of gender, age group, religion, marital status, the highest education level, and country of origin, as shown in Table 1. The total number of participants was 462 who filled out the questionnaires; among them, 312 (67.5%) and 150 (32.5%) were male and female, respectively. 53.2% of them were in the 26-30 age group. Regarding education and marital status, 58.6% held a bachelor's degree, 81.2 % were single, and

94.2% identified as Christian by religion. 58.7% of the participants reported that they did not receive COVID-19 vaccines since vaccination against the COVID-19 program started.

Table 1. General characteristics of participants (N = 462).

Variables	n	%
Gender		
Male	312	67.5
Female	150	32.5
Age		
18-25	108	23.4
26-30	246	53.2
31-35	99	21.4
36-40	9	2
Marital status		
Single	375	81.2
Married	87	18.8
Divorced	0	0
Widowed	0	0
Religion		
Islam	18	4
Christian	435	94.2
Buddhism	6	1.2
Others	3	0.6
Education Level		
High school	36	7.8
Diploma degree	35	7.6
Bachelor's degree	271	58.6
Masters/PhD	120	26
Major of Study		
Medicine/Public Health	111	24
Engineering	142	30.7
Education	39	8.4
Agriculture	48	10.4
Economics	57	12.4
Others	65	14.1

n=number, %: percentages

3.1. *Knowledge towards the COVID-19 vaccine*

A series of Yes or No questions were employed to evaluate respondents' general knowledge of the COVID-19 vaccine. Table 2 shows the proportion of each knowledge element concerning the COVID-19 vaccine.

Table 2. Distribution of each knowledge item and gender difference.

Variables	Total n (%)	Male n (%)	Female n (%)	X2	*P-Value*
Do you know about the COVID-19 vaccine?					
Yes	405 (87.7)	279 (89.4)	126 (84)	2.75	*0.097*
No	57 (12.3)	33 (10.6)	24 (16)		
Do you know about the effectiveness of the COVID-19 vaccine?					
Yes	399 (86.4)	269 (86.2)	130 (86.7)	0.017	*0.89*
No	63 (13.6)	43 (13.8)	20 (13.3)		
Is it dangerous to use overdose COVID-19 vaccines?					
Yes	414 (89.6)	279 (89.4)	135 (90)	0.036	*0.85*
No	48 (10.4)	33 (10.6)	15 (10)		
Does vaccination increase allergic reactions?					
Yes	216 (46.8)	161 (51.6)	55 (36.7)	9.077	***0.003***
No	246 (53.2)	151 (48.4)	95 (63.3)		
Have you heard about community (herd) immunity?					
Yes	205 (44.4)	155 (49.7)	50 (33.3)	10.96	***0.001***
No	257 (55.6)	157 (50.3)	100 (66.7)		
Does vaccination increase autoimmune diseases?					
Yes	195 (42.2)	129 (41.3)	66 (44)	0.29	*0.59*
No	267 (57.8)	183 (58.7)	84 (56)		

Significant values are in Italic and bolded, p-value less than 0.05, n=number, X^2: Chi-square test, %: percentages.yty

The percentage grade of knowledge was significantly different based on gender. Females compared to males' participants correctly answered a question related to vaccination and allergic reactions (63.3% vs. 48.4% with $P<0.05$) while males compared to females had good knowledge of a question related to community (herd) immunity (49.7% vs. 33.3% with $P=0.001$). Social media was the main source of information concerning COVID-19 vaccines Figure 1.
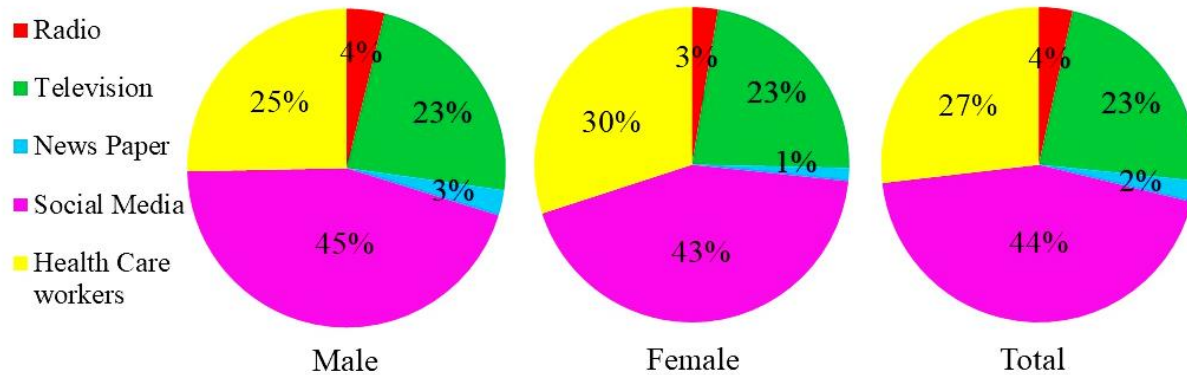
Figure 1. Source of information about COVID-19 vaccines.

3.2. *Perceptions towards COVID-19 vaccines*

The proportion of each perception item regarding COVID-19 vaccine is revealed in Table 3.

Table 3. The distribution of each perception item, as well as gender differences.

Variables	Total n (%)	Male n (%)	Female n (%)	X2	Value	P-
Do you think the COVID-19 virus is real?						
Yes	126 (27.3)	95 (30.4)	31 (20.7)	5.867	**0.019**	
No	23 (5)	17 (5.5)	6 (4)			
Don't know	313 (67.7)	200 (64.1)	113 (75.3)			
Are you aware that vaccines have been developed to protect people against COVID-19?						
Yes	375 (81.2)	249 (79.8)	126 (84)	1.165	0.281	
No	87 (18.8)	63 (20.2)	24 (16)			
You can get a disease after you have been vaccinated against that disease						
Strong Agree	99 (21.4)	78 (25)	21 (14)	11.981	**0.003**	
Agree	117 (25.3)	81 (26)	36 (24)			
Not sure	192 (41.6)	123 (39.4)	69 (46)			
Disagree	36 (7.8)	18 (5.8)	18 (12)			
Strong disagree	18 (3.9)	12 (3.8)	6 (4)			
Having been vaccinated against a disease can reduce the severity of the disease						
Strong Agree	150 (32.5)	111 (35.6)	39 (26)	7.401	0.357	
Agree	198 (42.9)	123 (39.4)	75 (50)			
Not sure	96 (20.8)	66 (21.2)	30 (20)			
Disagree	15 (3.2)	9 (2.9)	6 (4)			

Strong disagree	3 (0.6)	3 (0.9)	0 (0)		
COVID-19 vaccine can prevent COVID-19 infection and its complications					
Strong Agree	81 (17.5)	60 (19.2)	21 (14)	3.87	0.155
Agree	174 (37.7)	120 (38.5)	54 (36)		
Not sure	186 (40.3)	117 (37.5)	69 (46)		
Disagree	12 (2.6)	9 (2.9)	3 (2)		
Strong disagree	9 (1.9)	6 (1.9)	3 (2)		
Does taking a COVID-19 vaccine mean that you should stop all preventive measures?					
Yes	108 (23.4)	66 (21.2)	42 (28)	2.651	0.104
No	354 (76.6)	246 (78.8)	108 (72)		
COVID-19 vaccine is a means to implant a digital microchip or a tracking device to control people					
Strong Agree	24 (5.2)	12 (3.8)	12 (8)	26.972	**<0.001**
Agree	30 (6.5)	15 (4.8)	15 (10)		
Not sure	246 (53.3)	165 (52.9)	81 (54)		
Disagree	81 (17.5)	48 (15.4)	33 (22)		
Strong disagree	81 (17.5)	72 (23.1)	9 (6)		

p-value <0.05, n=number, X^2: Chi-square test, %: percentages.

Concerning the question "you can get a disease after being vaccinated against that disease," just over 42% of participants responded that they are not sure. Females had a substantially greater perception than males (46% vs. 39.4%, p=0.003). 53.3% responded that they are unsure if COVID-19 vaccines are the means to implant digital microchips or a tracking device to control people, which was considerably greater in females compared to males (54% vs. 52.9%, p =0.001). Nearly 75.4% of respondents think that after being vaccinated, you may also keep all preventive measures to control the spread of COVID-19, which was not statistically significant. In addition, most participants are aware that COVID-19 vaccines were developed to protect people against COVID-19 (81.9%). To reply to "Do you think the COVID-19 virus is real?", slightly more than half of the participants (67.7%) responded that they "don't know." Females had a substantially greater perception of the situation than males (75.3% vs. 64.1% with P=0.019). Thus, community health education is needed to influence the perception of the COVID-19 vaccination positively.

3.3. *The acceptability towards COVID-19 vaccines*

Table 4 illustrates the general acceptance/refusal of a proposed COVID-19 vaccine among the study's participants. At the time of conducting our study, 56.7% were not vaccinated against COVID-19. In general, most respondents answered "strong disagree" (42.2%), "Moderately disagree" (13%), and "Slightly disagree" (6.5%) in response to "If a COVID-19 vaccine is

available, I plan to be vaccinated", whereas 22.7% moderately agreed to be vaccinated and 15.6% are neutral. As a result, the acceptance group (i.e., moderately agree will get vaccinated) made up 22.7%, equal to 105/462 of the whole sample population. In response to "Everyday stresses prevent me from getting vaccinated," 40.9% said "Strongly disagree," 15% said "Moderately disagree," and 22.1% said "Slightly disagree," while 5.8% said "Moderately agreed" and 15.6% said "Neutral. "This shows that 5.8% (moderately agree) were having stress preventing them from getting vaccinated. 23.4% of the total participants are the only ones who have extensive confidence that vaccines are safe. Only gender, age, and education were found to be statistically significantly related to perceptions (P-value <0.05). In terms of gender, the knowledge of participants about corvid-19 vaccines was not significant (P=0.097) Table 5. Therefore, this community needs more information on the safety and effectiveness of COVID-19 vaccines.

Table 4. The distribution of each acceptability item, as well as gender differences.

Variables	Total	Male	Female	X^2	*P-Value*
	n (%)	n (%)	n (%)		
Have you been vaccinated against COVID-19?					
Yes	200 (43.3)	138 (44.2)	62 (41.3)	0.346	0.56
No	262 (56.7)	174 (55.8)	88 (58.7)		
If a COVID-19 vaccine is available, I plan to be vaccinated					
Strong disagree	195 (42.2)	153 (49)	42 (28)	20.5	*<0.001*
Moderately disagree	60 (13)	39 (12.5)	21 (14)		
Slightly disagree	30 (6.5)	15(4.8)	15 (10)		
Neutral	72 (15.6)	42(13.5)	30 (20)		
Moderately agree	105 (22.7)	63(20.2)	42 (28)		
I am completely confident that vaccines are safe					
Strong disagree	114 (24.7)	81 (26)	33 (22)	3.45	0.17
Moderately disagree	66 (14.3)	45 (14.4)	21 (14)		
Slightly disagree	51 (11)	33 (10.6)	18 (12)		
Neutral	123 (26.6)	87 (27.9)	36 (24)		
Moderately agree	108 (23.4)	66 (21.1)	42 (28)		
COVID-19 is not so severe that I should get vaccinated					
Strong disagree	132 (28.6)	102 (32.7)	30 (20)	9.57	0.108
Moderately disagree	87 (18.8)	51 (16.3)	36 (24)		
Slightly disagree	69 (14.9)	45 (14.4)	24 (16)		
Neutral	117 (25.3)	78 (25)	39 (26)		
Moderately agree	57 (12.4)	36 (11.6)	21 (14)		
Everyday stresses prevent me from getting vaccinated					
Strong disagree	189 (40.9)	144 (46.2)	45 (30)	11.63	*0.012*

Moderately disagree	72 (15.6)	45 (14.4)	27 (18)		
Slightly disagree	102 (22.1)	63 (20.2)	39 (26)		
Neutral	72 (15.6)	42 (13.5)	30 (20)		
Moderately agree	27 (5.8)	18 (5.7)	9 (6)		
I get vaccinated because I can also protect other people from getting infected					
Strong disagree	307 (66.5)	205 (65.7)	102 (68)	6.89	0.338
Moderately disagree	46 (10)	32 (10.3)	14 (9.3)		
Slightly disagree	19 (4.1)	14 (4.5)	5 (3.3)		
Neutral	51 (11)	29 (9.3)	22 (14.7)		
Moderately agree	39 (8.4)	32 (10.2)	7 (4.7)		

Significant values are in Italic and bolded, p-value less than 0.05, n=number, X^2: Chi-square test, %: percentages.

Table 5. Group difference analysis (bivariate) with knowledge and attitudes scores

Variables	Knowledge			Perceptions		
	Mean (SD)	**F**	*P-value*	**Mean (SD)**	**F**	*P-value*
Gender						
Male	0.69 (0.53)	0.023	0.879	2.03 (1.26)	73.375	*<0.001*
Female	0.69 (0.53)			1.52 (1.27)		
Age						
18-25	0.67 (0.55)	0.666	0.573	1.67 (1.27)	5.768	*0.001*
26-30	0.7 (0.52)			1.93 (1.29)		
31-35	0.66 (0.55)			1.98 (1.27)		
36-40	0.69 (0.59)			2.00 (1.10)		
Education						
High school	0.65 (0.55)	0.826	0.479	1.75 (1.29)	3.248	*0.021*
Diploma degree	0.73 (0.56)			1.62 (1.27)		
Bachelor's degree	0.69 (0.53)			1.93 (1.28)		
Masters/PhD	0.68 (0.52)			1.90 (1.29)		

Significant values are in Italic and bolded, p-value less than 0.05, SD: standard deviation, F: variation between sample means/variation within samples in ANOVA.

4. Discussion

Immunization has figured prominently in decreasing the risk of infectious illnesses in recent years. In 2001, it averted 33,000 demises and 14 million illnesses (12). A large number of vaccine prototypes are being studied. Some clinical studies have previously been reported with impressive results, diving into the approval of particular vaccines for use in immunization programs in many countries (13). Once the vaccine is widely accessible, identifying the population's desire to get vaccinated and the constraints on vaccination might help remove these

obstacles and boost vaccination rates. China has made significant investments in vaccinations and is a key player in the race to find a vaccine to combat the COVID-19 pandemic (14). Even though China provides a diversity of vaccination facilities, the COVID-19 vaccination roll-out could raise worries regarding vaccine distribution and acceptability among overseas students in China. The international students' knowledge, perceptions, and acceptance of the COVID-19 vaccine and its implementation could be considered. The outcomes of this unique research in China provide the international students' knowledge, perceptions, and acceptance of the COVID-19 immunization. The results reflect various socio-demographic characteristics that influence COVID-19 vaccination knowledge, perceptions, and acceptance. Lastly, the findings might be useful in building COVID-19 vaccine awareness and health education initiatives.

More than¾ of the total participants were aware of COVID-19 vaccinations. In this study, there was no evidence that knowledge was associated with education or past vaccine coverage experience (P-value > 0.05). Only gender, age, and education were found to be statistically significantly related to perceptions (P-value <0.05). In terms of gender, the knowledge of participants about COVID-19 vaccines was not significant (*P=0.097*). Most respondents (81.2%) had positive perceptions of the COVID-19 vaccine since they agreed it was produced to protect people against COVID-19 disease. The males were more aware of the COVID-19 vaccine than the females. This result was inconsistent with the previous research in Bangladesh on COVID-19 knowledge, where females had marginally higher scores in COVID-19 knowledge than males (15,16). This current research found that 44 % acquired knowledge about COVID-19 through social media platforms (WeChat, Twitter, Facebook, etc.), while 27 % got information about COVID-19 from health care workers. Therefore, ¼ knowledge gaps among the respondents discovered in this study could be due to limited access to COVID-19 vaccination information. This is supported by a survey carried out by Africa CDC on 15 countries related to COVID-19 vaccine perceptions, whereas nearly two-thirds (64%) of respondents from 15 countries revealed television as one of their most trustworthy sources of information about COVID-19, followed by radio (51%), online sources (41%), health organizations (23%), and government sources (18%). Their results contrasted substantially depending on the region.

The people polled in North Africa, notably Morocco and Tunisia, were more likely to point to government and healthcare institutions as a source of information (17). The findings indicate certain forms of information that might be very useful and specific populations that could gain from unambiguous and specific messages to encourage participation in health-promoting activities. Vaccine apprehension could undermine the efficacy of COVID-19 vaccines once they become widely available (18). The existence of contradictory reports about gender effects indicated that males were more likely than females to accept the injection, and the rest stated that females were more expected to accept the vaccine (19). However, this survey revealed females to be more likely to take the injection, which is different from other studies, whereas males were more likely than females to engage in COVID-19 vaccine clinical studies (20,21). Different factors, including background and beliefs, can induce a low level of acceptability for COVID-19 vaccinations among people in the community. The current study showed that 23.4%of the participants moderately agreed on the vaccine's safety once it became accessible, as evidenced by

their concern about potential adverse effects. However, more than half disagreed with being vaccinated if the vaccine would be available, and 15.6% were neutral. This disparity could be attributed to their doubts about the vaccine's health implications. The facts backed up such perceptions, as individuals who did not believe in a COVID-19 conspiracy were more eager to accept COVID-19 injections. Therefore, it is crucial to think about vaccination convenience in terms of accessibility and pricing during the investigation into the acceptability of vaccines towards the public (22).

5. Conclusion

This study provides insight into the knowledge, perceptions, and acceptability of the COVID-19 vaccine among international students. It was discovered that the majority of participants obtained information about COVID-19 from social media, which is an untrustworthy source of disease evidence. Thus, international students should be advised about reliable news sources, such as those supplied by global health agencies and national health ministries. This finding can support the Department of Health in planning future attempts to enhance vaccination acceptance, contributing to herd immunity against COVID-19. Therefore, it is recommended to provide unique campaigns and outreach in different universities with international students to overcome wrong myths about COVID-19 vaccine.

Authors' contribution:

Jean Nepomuscene Ntezimana, Habasi Patrick Manzi, Emmanuel Habinshuti, Yi-Min Wang, and Angelique Kwizera contribute equally to Conceptualization, Methodology, Visualization, Investigation, Data curation, Formal analysis, and Writing, Therefore, all authors should be considered as first authors.

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