BMJ Open

Vaccination coverage among COVID-19 prevention and control management teams at primary healthcare facilities in China and their attitudes towards COVID-19 vaccine: a cross-sectional online survey

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To cite: Yan Y-Y, Wang H-T, Fan T-Y, *et al*. Vaccination coverage among COVID-19 prevention and control management teams at primary healthcare facilities in China and their attitudes towards COVID-19 vaccine: a cross-sectional online survey. *BMJ Open* 2022;**12**:e056345. doi:10.1136/bmjopen-2021-056345

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2021-056345).

Received 11 August 2021
Accepted 16 March 2022

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ABSTRACT

Objective To investigate the COVID-19 vaccination coverage rate and differences among various COVID-19 prevention primary healthcare (PHC) facilities in China and understand their attitudes towards COVID-19 vaccine. These findings are helpful to provide important suggestions to further improve national COVID-19 vaccination rate.

Design A nationwide cross-sectional online survey was designed and conducted among COVID-19 prevention and control management teams at PHC facilities in mainland China. In the self-designed questionnaires, each subject was asked to evaluate on a 1–10 scale (10=extremely important/acceptable/influential) the COVID-19 vaccination importance, acceptance and factors related to vaccine hesitancy.

Setting Subjects from 31 provinces and autonomous regions including minorities across mainland China were invited to complete the questionnaire between 22 February 2021 and 2 March 2021.

Participants Were selected by multistage stratified sampling, 998 valid questionnaires (valid rate 99.11%) were collected. The respondents were divided into group A (≤5 respondents within each PHC facility, n_1=718) and group B (>5 respondents within each PHC facility, n_2=280).

Outcome measures Survey on vaccination rate and attitude towards COVID-19 vaccine included the following: (1) if the subjects think the vaccination is important in containment of COVID-19 pandemic (1–10 scale, 10=extremely important), (2) if they would accept COVID-19 vaccine (1–10 scale, 10=extremely acceptable) and (3) their opinions on 7 factors possibly related to vaccine hesitancy (1–10 scale, 10=extremely influential). All the items were designed based on the previous expert interviews.

Results Our results showed vaccination rate was greater in group A (85.93%) than in group B (66.43%) (p<0.001). Detailed analyses revealed that in group A, male members were twice as likely to get vaccinated as compared with female members (adjusted OR (aOR): 2.07; 95% CI: 1.26 to 3.43, p=0.004). In group B, those who were at or under the median age had twice the odds of vaccination coverage compared with those who were over the median age (aOR: 2.29; 95% CI: 1.22 to 4.33, p=0.010). In addition, those who were specialised in traditional Chinese medicine were less likely to get vaccinated against COVID-19 compared with those who were specialised in general medicine, with the aOR: 0.10 (95% CI: 0.01 to 0.83, p=0.033). By analysing the factors that influenced the vaccination attitudes among the 998 respondents, we found no significant difference between the vaccinated and unvaccinated participants. However, further detailed analyses found that team members with undergraduate college education were less likely to score higher in COVID-19 vaccination importance than those with technical secondary school education (aOR: 0.35; 95% CI: 0.13 to 0.93, p=0.035); Furthermore, those with non-medical job titles had nearly twice the odds of giving a higher score for the uncertainty of vaccine efficacy compared with those with junior medical titles (aOR: 1.70; 95% CI: 1.02 to 2.85, p=0.016). Team members with a non-medical title were more likely to give a higher score for advice on social sources compared with those with a junior medical title (aOR: 1.70; 95% CI: 1.02 to 2.85, p=0.042).

Conclusion In PHC facilities, although there was a higher COVID-19 vaccination rate among COVID-19

Strengths and limitations of this study

- ► This is an online survey that makes it easier in questionnaire distribution and data collection.
- ► It is a nationwide cross-sectional survey across mainland China.
- ► Multistage stratified sampling was used to select targeted subjects.
- ► One limitation is that participants were not selected randomly.
- ► Also, the response could only reflect the status when the survey was conducted and the situation might have changed over time.

prevention and control teams, some subgroups with different descriptive characters showed negative attitudes towards COVID-19 vaccination. Because primary care workers in China are highly expected to receive the vaccination, and support and educate the public for COVID-19 vaccination. Thus, it is important and necessary to continue to educate them about their vaccination concerns and change their attitudes towards vaccination. Our findings are highly beneficial for designing public vaccination education strategies.

BACKGROUND

The currently ongoing COVID-19 pandemic has been a challenge for healthcare all over the world since late 2019. All efforts were devoted to reducing the SARS-CoV-2 infection rate, and then to delay or prevent the progression of severe or critical COVID-19 infections, which in turn could decrease the fatality rate and substantially reduce the economic burden for the public and the whole society. As the COVID-19 pandemic remains an ongoing global public health challenge, it is well recognised that reinforcement of vaccination against COVID-19 to establish herd immunity seems to be the most feasible and cost-effective way to curb the unprecedented global pandemic.[1] A computational model simulated that the COVID-19 epidemic could be prevented when the vaccine is up to 70% effective, and basically eliminated when the vaccine efficacy reaches 80%.[2] Besides, as several types of COVID-19 vaccines were under development and some of them have gone into clinical use in COVID-19 prevention, increasing vaccine coverage becomes a major effort worldwide.[3]

Before our study, even when the vaccination was unavailable for some time, a considerable number of studies focused on the attitudes towards hypothetical COVID-19 vaccine were conducted globally. Although the expected acceptance intentions among healthcare workers (HCWs) were relatively high (>70%),[4] the expected acceptance rate varied (from 29.4% to 70%) among the public individuals.[5–7]As for now, countries all over the word promoted and facilitated nationalised COVID-19 vaccination programme. However, differences in the vaccination rate existed among different groups of populations in England[8] and Rome.[9] Furthermore, as variants of SARS-CoV-2 as Delta[10] and Omicron[11] emerged, a booster shot becomes strongly recommended to achieve public health targets.[12] Therefore, it is still important to make efforts to achieve a satisfactory COVID-19 vaccination coverage.

In China, primary healthcare (PHC) facilities including community healthcare centres, township health centres as well as local village and community clinics were obligated to provide vaccine for both healthcare providers and the public.[13] According to official statistics, the total number of PHC facilities consist of approximate 71 000 community healthcare centres/township health centres and 853 000 local village/community clinics.[14] The former part of PHC facilities were qualified for providing immunisation services for the public individuals. Since 15 December 2020, the National Health Commission of People's Republic of China issued a plan of COVID-19 vaccination among high-risk populations including HCWs.[15] After 29 March 2021, the extended COVID-19 vaccination programme was provided to the public population.[16]

The healthcare providers at PHCs played an important role in COVID-19 vaccination programme in China since they are expected to receive vaccination, and educate and provide vaccine to the public. First, as service recipients, they were one of the first people who received COVID-19 vaccines in China. Second, as the COVID-19 vaccination service providers in China, their attitudes towards vaccines will have direct impact on nationwide vaccine acceptance rate. Thus, we designed this survey study for this special period between the vaccination of high-risk populations including primary care physicians (PCPs) and the expanded public vaccination, aiming to improve actual COVID-19 vaccination rate and attitude nationwide.

METHODS

A nationwide online survey was conducted and a multistage stratified sampling strategy was used. The participants were selected from members of COVID-19 prevention and control management team from PHC facilities. The surveyed subjects must have fully engaged in the prevention and containment tasks from the beginning of COVID-19 pandemic. The research was carried out from 22 February 2021 to 2 March 2021.

PHC facilities and participants

All of the 31 provinces and autonomous regions including minorities across mainland China were included in this survey. In each province and autonomous region, five cities or districts especially those that were once identified as high-risk or medium-risk areas during the COVID-19 pandemic were purposively selected. In each city or district, three PHC facilities from the urban, urban-rural and rural areas were chosen separately. Finally, within each PHC facility, members of COVID-19 prevention and control management team were fully engaged and invited to complete the questionnaire (figure 1).

Patient and public involvement

Patients and/or the public were not involved in the design, conducting, reporting or dissemination of this research.

Questionnaire development

After comprehensive literature search in English and Chinese electronic database, we also did tele-interviews with five major primary care experts from Shanghai and Zunyi, Guizhou province before the original version of questionnaire was designed. Face-to-face expert interviews were then conducted from November to December 2020. At 16 PHC facilities located in urban, urban-rural and rural areas of three selected cities (Shanghai—medium-risk city in eastern China, Wuhan, Hubei province—high-risk city

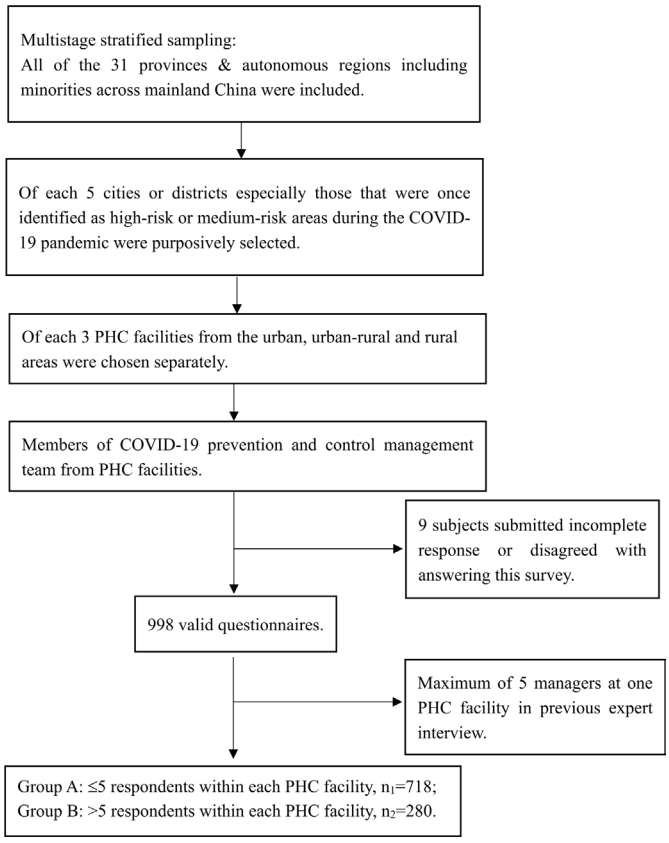

Figure 1 Participant selection in the nationwide cross-sectional online survey in China. Vaccination coverage among COVID-19 prevention and control teams at primary healthcare (PHC) facilities in China and their attitudes towards COVID-19 vaccine.

in central China and Zunyi, Guizhou province—low-risk city in western China), 32 public healthcare facilities who served as team members of COVID-19 prevention and control management programme were interviewed for the topics raised in the original version of questionnaire.

Although there were scales and models available to measure vaccine hesitancy, they were not likely to be suitable because the relatively short time period in COVID-19 vaccine development caused public distrust. During the specific phase of regular COVID-19 prevention and control, only sporadic cases were diagnosed daily here in China. The selected subjects of this survey were both vaccination service receivers and providers. Vaccination fee was not considered as a factor due to the policy of free vaccination for all citizens in China.

In this survey, we used a self-designed questionnaire based on the results of expert interviews to investigate the vaccine attitudes. First, as the future vaccination service providers, the subjects were required to answer if the COVID-19 vaccination programme is important in containing COVID-19 pandemic. The second question was about the vaccination acceptance. During the previous interviews, we learnt that regardless of the vaccination status, some of the interviewees were not fully supportive of COVID-19 vaccination. The third part of our survey was about the attitude on the factors that might lead to vaccine hesitancy.

According to our survey, their first and biggest concern was the vaccine safety/efficacy. Some interviewees reported that advice received from friends and families was the major motivation for their vaccination decision making. Another reason for some interviewees to be vaccinated was simply because they were the first ones qualified to receive COVID-19 vaccine and the organised vaccination activity was convenient for them. However, some of them experienced vaccine shortage and waited for a few days to receive COVID-19 vaccine.

As health and public care management team members, some subjects thought that a high vaccination rate is required to achieve adequate herd immunity for protection of unvaccinated populations, so that some would rather wait for others to be vaccinated at the same time. In addition, some of them reported no particular reasons but simply did not want to receive COVID-19 vaccination.

Based on the advices of interviewees, we revised the questionnaire and eventually adapted it into an online version.

Questionnaire

The questionnaire consisted of the basic information section, a question of whether they were vaccinated against COVID-19 and their attitudes towards COVID-19 vaccination. The basic information section included demographic information, the highest grade of risk level which the area of PHC facilities had ever reached during the COVID-19 pandemic and the introcity locations of the PHC facilities. Demographic information included age, sex, educational levels, specialty, technical titles and years of work experience.

The questionnaire included a question requiring a yes/no response regarding the COVID-19 vaccination status.

The attitudes towards COVID-19 vaccination were assessed by scoring the importance, acceptance and the influencing factors of vaccine reluctancy. The vaccine hesitancy influencing factors include: uncertainty of safety/efficacy, advice from social resources (friends and families), the perception that only high vaccination rates could protect unvaccinated populations and hoping for public vaccination, waiting for organised vaccination activities, vaccine shortage, unwillingness to receive COVID-19 vaccine. In addition, the respondents were allowed to submit their own opinions of influence factors. A scale from 1 to 10 was used to evaluate the attitudes. For vaccination importance, a score of 10 represents being extremely important; for vaccination acceptance, a score of 10 means extremely acceptable and for factors related to vaccine hesitancy, a score of 10 is extremely influential.

The questionnaire was distributed by WeChat and website hyperlinks. The participants were anonymous throughout the survey. Before the questionnaire, an electronic consent form was provided and only after the informed consent was obtained, the questionnaire was valid.

Data analysis

Categorical variables were described as the number of cases and percentages. All statistical analyses were performed using SPSS V.22.0 (IBM SPSS) and a two-sided p value <0.05 was considered statistically significant. The χ^2 test was used for categorical variables in comparing differences between and within groups. The reliability and validity of the attitude scores towards COVID-19 vaccination were assessed. The reliability of internal consistency was examined using Cronbach's α, and a Bartlett test of sphericity and a Kaiser-Meyer-Olkin (KMO) measure were used to test construct validity. A logistic regression model was employed to identify determinants of participants' attitudes towards COVID-19 vaccine and whether they were already vaccinated. In the first step, associations between explanatory variables and attitudes or vaccination status were analysed separately. In the second step, all variables with p≤0.25 in the first step were included in the adjusted analysis. The crude OR from univariate analyses and the significance of adjusted OR (aOR) in multivariate analyses were also assessed.

RESULTS

A total of 1007 questionnaires were returned, of which 998 were valid, with an effective rate at 99.11%. In the previous field survey, we learnt that there were at most five members who were hired for each COVID-19 prevention and control management team within one PHC facility. However, among all of the 998 valid online questionnaire respondents, 280 were from 13 PHC facilities in which the minimum responding number were 6. Based on the χ^2 test results, the characteristic features of the 280 respondents were different from the other part of the respondents (online supplemental table S1). Therefore, the 998 respondents were divided as group A (≤5 respondents within each PHC facility, n_1=718) and group B (>5 respondents within each PHC facility, n_2=280) and analysed separately. Group B facilities are likely to cover a larger population.

COVID-19 vaccination coverage and associated factors

Of all respondents, 803 (80.46%) were vaccinated and the other 195 (19.54%) were not (or not yet). A significant difference was noticed between two groups. The vaccination coverage rate was greater in group A (85.93%) than in group B (66.43%) (p<0.001, online supplemental table S1).

In group A, an adjusted analysis found that male members showed a higher vaccination coverage rate than female members (table 1). In fact, male members were twice as likely to get vaccinated compared with female members (aOR: 2.07; 95% CI: 1.26 to 3.43, p=0.004) (table 1).

In group B, members who were at or under the median age had twice the percentage of vaccination coverage compared with those who were over the median age (aOR: 2.29; 95% CI: 1.22 to 4.33, p=0.010) (table 1). In addition, those who were specialised in traditional Chinese medicine were less likely to get vaccinated against COVID-19 compared with those who were specialised in general medicine, with the aOR: 0.10 (95% CI: 0.01 to 0.83, p=0.033) (table 1).

Reliability and validity of the attitude scale

The reliability of the attitude scaling was good that the internal consistency reliability (Cronbach's α coefficient) was 0.772 in group A and was 0.833 in group B. The Bartlett test of sphericity and KMO measure verified the sampling adequacy for the analysis (group A: KMO=0.789, Bartlett test of sphericity p<0.001; group B: KMO=0.839, Bartlett test of sphericity p<0.001). Factor analysis was not performed because the number of variables was limited.

Attitude scores towards COVID-19 vaccination

Regarding to COVID-19 vaccination, the median importance score was given 10 by both group A and group B. The median acceptance score was 7 in group A and 6 in group B and there was no statistical difference (online supplemental table S2). In terms of vaccine hesitancy, an adjusted analysis found that respondents of group B scored slightly higher in their unwillingness to receive COVID-19 vaccine compared with group A (aOR: 1.07; 95% CI: 1.01 to 1.13, p=0.010) (online supplemental table S3).

Associated factors of attitudes towards COVID-19 vaccination

Although the vaccination rate was significantly different between group A and group B, the adjusted analysis showed no relevance in attitude scores towards COVID-19 vaccination between vaccinated and unvaccinated respondents (online supplemental table S4). Therefore, we employed logistic analysis to identify factors associated with attitude score of COVID-19 vaccination among all the 998 respondents. Table 2 only listed the results which were statistically significant in adjusted analysis and online supplemental table S5 showed all of the results which were statistically significant in unadjusted analysis.

Among members of primary care management team, the adjusted analysis found that those with undergraduate college education were less likely to score higher in COVID-19 vaccination importance compared with those with technical secondary school education (aOR: 0.35; 95% CI: 0.13 to 0.93, p=0.035); those who were unvaccinated were less likely to score higher in COVID-19 vaccination importance compared with those who were vaccinated (aOR: 0.57; 95% CI: 0.38 to 0.84, p=0.004) (table 2). Female members were less likely to give a higher score in vaccine acceptance compared with male members (aOR: 0.62; 95% CI: 0.47 to 0.82, p<0.001) (table 2).

As for influencing factors of vaccine hesitancy, members of primary care management team with non-medical titles had nearly twice the odds of given a higher score of uncertainty of vaccine safety compared with those with junior medical titles (aOR: 1.90; 95% CI: 1.13 to 3.19, p=0.016)

Table 1 Factors associated with COVID-19 vaccination coverage among team members of COVID-19 prevention and control management from PHC facilities in mainland China

	Group A (n_1=718)						Group B (n_2=280)					
			Unadjusted		Adjusted				Unadjusted		Adjusted	
Characteristics	Vaccinated (n (%))	Unvaccinated (n (%))	OR (95% CI)	P value	OR (95% CI)	P value	Vaccinated (n (%))	Unvaccinated (n (%))	OR (95% CI)	P value	OR (95% CI)	P value
Overall	617 (85.93)	101 (14.07)	—				186 (66.43)	94 (33.57)	—			
Age												
At or under the median age	319 (84.17)	60 (15.83)	0.73 (0.48 to 1.12)	0.152	1.16 (0.57 to 2.37)	0.675	107 (71.81)	42 (28.19)	1.68 (1.02 to 2.76)	0.043*	2.29 (1.22 to 4.33)	0.010*
Over the median age	298 (87.91)	41 (12.09)	1	—	1	—	79 (60.31)	52 (39.69)	1	—	1	—
Sex												
Male	253 (91.34)	24 (8.66)	2.23 (1.37 to 3.62)	0.001*	2.07 (1.26 to 3.43)	0.004*	37 (71.15)	15 (28.85)	1.31 (0.68 to 2.53)	0.425		
Female	364 (82.54)	77 (17.46)	1	—	1	—	149 (65.35)	79 (34.65)	1	—		
Educational level												
Technical secondary school	25 (83.33)	5 (16.67)	1	—			19 (65.52)	10 (34.48)	1	—		
College	155 (85.16)	27 (14.84)	0.87 (0.31 to 2.47)	0.795			82 (63.08)	48 (36.92)	1.11 (0.48 to 2.59)	0.805		
Undergraduate college	411 (86.89)	62 (13.11)	0.75 (0.28 to 2.04)	0.579			78 (70.91)	32 (29.09)	0.78 (0.33 to 1.86)	0.574		
Graduate school	19 (82.61)	4 (17.39)	1.05 (0.25 to 4.46)	0.944			3 (100)	0	—	—		
Others	7 (70)	3 (30)	2.14 (0.41 to 11.26)	0.368			4 (50)	4 (50)	1.90 (0.39 to 9.26)	0.039		
Specialty												
General medicine	119 (86.23)	19 (13.77)	1	—			2 (28.57)	5 (71.43)	1	—	1	—
Clinical medicine	174 (85.29)	30 (14.71)	1.08 (0.58 to 2.01)	0.808			35 (71.43)	14 (28.57)	0.16 (0.03 to 0.92)	0.040*	0.16 (0.02 to 1.20)	0.075
Traditional Chinese medicine	53 (88.33)	7 (11.67)	0.83 (0.33 to 2.09)	0.688			26 (78.79)	7 (21.21)	0.11 (0.02 to 0.68)	0.018*	0.10 (0.01 to 0.83)	0.033*
Nursing	161 (83.85)	31 (16.15)	1.21 (0.65 to 2.24)	0.553			74 (65.49)	39 (34.51)	0.21 (0.04 to 1.14)	0.070	0.28 (0.04 to 1.97)	0.202
Others	110 (88.71)	14 (11.29)	0.80 (0.38 to 1.67)	0.657			49 (62.82)	29 (37.18)	0.24 (0.04 to 1.30)	0.097	0.25 (0.03 to 1.80)	0.167
Technical title												
Junior	206 (83.74)	40 (16.26)	1	—	1	0.813	113 (68.90)	51 (31.10)	1	—	1	—
Intermediate	221 (87.35)	32 (12.65)	0.75 (0.45 to 1.23)	0.252	0.81 (0.47 to 1.38)	0.432	47 (77.05)	14 (22.95)	0.66 (0.33 to 1.31)	0.233	0.43 (0.19 to 0.95)	0.036*
Associate senior	133 (88.67)	17 (11.33)	0.66 (0.36 to 1.21)	0.178	0.78 (0.38 to 1.63)		0	8 (100)	—	—	—	—
Senior	22(88)	3 (12)	0.70 (0.20 to 2.46)	0.580	0.65 (0.17 to 2.49)		0	0	—	—	—	—
Others	35 (79.55)	9 (20.45)	1.32 (0.59 to 2.97)	0.495	1.26 (0.56 to 2.86)		26 (55.32)	21 (44.68)	1.79 (0.92 to 3.47)	0.085	2.18 (0.99 to 4.81)	0.053
Region												
Eastern	227 (86.31)	36 (13.69)	1	—			37 (74)	13 (26)	1	—	1	—
Central	170 (86.73)	26 (13.27)	0.96 (0.56 to 1.66)	0.896			29 (63.04)	17 (37.96)	1.67 (0.70 to 3.98)	0.249	1.84 (0.67 to 5.09)	0.237
Western	220 (84.94)	39 (15.06)	1.12 (0.69 to 1.82)	0.656			120 (65.22)	64 (34.78)	1.52 (0.75 to 3.06)	0.243	2.39 (0.96 to 5.96)	0.061
Introcity location												
Urban	285 (83.09)	58 (16.91)	1	—	1	0.237	113 (69.33)	50 (30.67)	1	—	1	—
Urban-rural	164 (87.70)	23 (12.30)	0.69 (0.41 to 1.16)	0.160	0.73 (0.43 to 1.23)	0.236	57 (64.77)	31 (35.23)	1.23 (0.71 to 2.13)	0.462	1.26 (0.66 to 2.40)	0.484
Rural	168 (89.36)	20 (10.64)	0.59 (0.34 to 1.01)	0.053	0.65 (0.37 to 1.14)	0.134	16 (55.17)	13 (44.83)	1.84 (0.82 to 4.10)	0.138	1.78 (0.73 to 4.38)	0.207

Continued

Table 1 Continued

Characteristics	Group A (n_1=718)						Group B (n_2=280)					
			Unadjusted		Adjusted				Unadjusted		Adjusted	
	Vaccinated (n (%))	Unvaccinated (n (%))	OR (95% CI)	P value	OR (95% CI)	P value	Vaccinated (n (%))	Unvaccinated (n (%))	OR (95% CI)	P value	OR (95% CI)	P value
Risk												
Low	552 (85.58)	93 (13.42)	1	–			181 (66.54)	91 (33.46)	1	–		
Medium	39 (86.76)	6 (13.33)	0.91 (0.38 to 2.22)	0.841			3 (60)	2 (40)	1.33 (0.22 to 8.08)	0.760		
High	26 (92.86)	2 (7.14)	0.46 (0.11 to 1.96)	0.291			2 (66.67)	1 (33.33)	0.99 (0.09 to 11.11)	0.996		
Years of work experience												
Equal or under the median years	304 (83.75)	59 (16.25)	0.69 (0.45 to 1.06)	0.090	0.71 (0.35 to 1.44)	0.342	100 (68.49)	46 (31.51)	1.21 (0.74 to 1.99)	0.445		
Over the median years	313 (88.17)	42 (11.83)	1	–	1	–	86 (64.18)	48 (35.82)	1	–		

Unadjusted and adjusted logistic regression analyses were used.
*P<0.05.
PHC, primary healthcare.

(table 2). The odds of giving a higher score of uncertainty of vaccine efficacy were quadrupled among those with graduate school educational backgrounds compared with those with technical secondary school educational backgrounds (aOR: 4.30; 95% CI: 1.53 to 12.10, p=0.006); similarly, those with non-medical titles had nearly twice the odds of given a higher score of uncertainty of vaccine efficacy compared with those with junior medical titles (aOR: 1.70; 95% CI: 1.02 to 2.85, p=0.016) (table 2).

The adjusted analysis found that vaccinated team members were less likely to give a higher score of hoping for others' vaccination to achieve a high public vaccination rate compared with unvaccinated members (aOR: 0.70; 95% CI: 0.50 to 0.97, p=0.031) (table 2). Those with a non-medical title were more likely to give a higher score of advice for social sources compared with those with a junior medical title (aOR: 1.70; 95% CI: 1.02 to 2.85, p=0.042, respectively) (table 2). Additionally, unvaccinated members were less likely to give a higher score in vaccine shortage compared with those who were vaccinated (aOR: 0.69; 95% CI: 1.04 to 1.94, p=0.028) (table 2).

DISCUSSION

This study was conducted during a special period in which members of COVID-19 prevention and control management teams from PHC facilities received COVID-19 vaccination as one of the first high-risk populations[15] before the establishment of public COVID-19 vaccination programme in China. [16] It was demonstrated that vaccination acceptance among HCWs could influence vaccination coverage on both themselves and the population they serve.[17] The PHC management members in mainland China act as both vaccine service receivers and providers. Our survey aims to illustrate the COVID-19 vaccination coverage among members of COVID-19 prevention and control management team from PHC facilities and conducted a further investigation of their attitudes towards COVID-19 vaccine. Our findings can provide several suggestions for further improving COVID-19 vaccination coverage nationwide.

First, our study found that COVID-19 vaccination coverage rate in group A was higher than in group B. The survey of attitudes towards COVID-19 vaccine was consistent with the difference between the two groups, as the members of group B scored slightly higher in their unwillingness to receive COVID-19 vaccine compared with members of group A. In our survey, the overall technical titles of group A were higher than group B. In a previous study, a survey among 8975 HCWs from different levels of hospitals or medical centres for disease control and prevention were conducted to investigate their willingness to get vaccinated against influenza. The researchers reported that HCWs with an associate senior title showed a lower acceptance of influenza vaccine than those with a junior title.[18] Unlike the results reported by Kong *et al*[18] about the survey on acceptance of influenza vaccine, our research indicated that the COVID-19 vaccination

Table 2 Factors associated with attitude score of COVID-19 vaccination among team members of COVID-19 prevention and control management from PHC facilities in mainland China (n=998)

Item/Characteristics	Equal or under the median score (n (%))	Over the median score (n (%))	Unadjusted		Adjusted	
			OR (95% CI)	P value	OR (95% CI)	P value
Importance						
Educational level						
Technical secondary school	5 (8.47)	54 (91.53)	1	—	1	—
College	52 (16.67)	260 (83.33)	0.46 (0.18 to 1.21)	0.117	0.46 (0.17 to 1.20)	0.112
Undergraduate college	109 (18.70)	474 (81.30)	0.40 (0.16 to 1.03)	0.058	0.35 (0.13 to 0.93)	0.035*
Graduate school	1 (3.85)	25 (96.15)	2.31 (0.26 to 20.87)	0.454	1.87 (0.20 to 17.22)	0.579
COVID-19 vaccination						
Vaccinated	125 (15.57)	678 (84.43)	1	—	1	—
Unvaccinated	47 (24.10)	148 (75.90)	0.58 (0.40 to 0.85)	0.005*	0.57 (0.38 to 0.84)	0.004*
Acceptance						
Sex						
Male	145 (44.07)	184 (55.93)	1	—	1	—
Female	379 (56.65)	290 (43.35)	0.60 (0.46 to 0.79)	<0.001*	0.62 (0.47 to 0.82)	<0.001*
Influencing factors of vaccine hesitancy						
Uncertainty of safety						
Technical title						
Junior	246(60)	164(40)	1	—	1	—
Intermediate	156 (49.68)	158 (50.32)	1.52 (1.13 to 2.04)	0.006*	1.32 (0.94 to 1.85)	0.115
Associate senior	74 (46.84)	84 (53.16)	1.70 (1.18 to 2.46)	0.005*	1.35 (0.87 to 2.11)	0.184
Senior	15 (60)	10 (40)	1.00 (0.44 to 2.28)	1.000	0.78 (0.31 to 1.92)	0.584
Others	39 (42.86)	52 (57.14)	2.00 (1.26 to 3.17)	0.003*	1.90 (1.13 to 3.19)	0.016*
Uncertainty of efficacy						
Educational level						
Technical secondary school	39 (66.10)	20 (33.90)	1	—	1	—
College	192 (61.54)	120 (38.46)	1.22 (0.68 to 2.19)	0.508	1.28 (0.71 to 2.33)	0.414
Undergraduate college	343 (58.83)	240 (41.17)	1.36 (0.78 to 2.40)	0.280	1.31 (0.72 to 2.38)	0.372
Graduate school	8 (30.77)	18 (69.23)	4.39 (1.63 to 11.83)	0.003*	4.30 (1.53 to 12.10)	0.006*
Others	7 (38.89)	11 (61.11)	3.06 (1.03 to 9.12)	0.044*	2.17 (0.69 to 6.83)	0.185
Technical title						
Junior	264 (64.39)	146 (35.61)	1	—	1	—
Intermediate	177 (56.37)	137 (43.63)	1.40 (1.04 to 1.89)	0.029*	1.27 (0.92 to 1.75)	0.141
Associate senior	91 (57.59)	67 (42.41)	1.33 (0.92 to 1.94)	0.134	1.16 (0.92 to 1.75)	0.483
Senior	15 (60)	10 (40)	1.21 (0.53 to 2.75)	0.657	1.01 (0.42 to 2.42)	0.983
Others	42 (46.15)	49 (53.85)	2.11 (1.33 to 3.34)	0.001*	1.90 (1.13 to 3.18)	0.015*
Hoping for others' vaccination						
COVID-19 vaccination						
Vaccinated	424 (52.80)	379 (47.20)	1	—	1	—
Unvaccinated	118 (60.51)	77 (39.49)	0.73 (0.53 to 1.00)	0.053	0.70 (0.50 to 0.97)	0.031*
Advice of social sources						
Technical title						
Junior	251 (61.22)	159 (38.78)	1	—	1	—
Intermediate	155 (49.36)	159 (50.64)	1.62 (1.20 to 2.18)	0.001*	1.52 (1.08 to 2.15)	0.017*
Associate senior	81 (51.27)	77 (48.73)	1.50 (1.04 to 2.17)	0.031*	1.31 (0.83 to 2.07)	0.242
Senior	11 (44)	14 (56)	2.01 (0.89 to 4.54)	0.093	1.59 (0.65 to 3.87)	0.305
Others	43 (47.25)	48 (52.75)	1.76 (1.12 to 2.78)	0.015*	1.70 (1.02 to 2.85)	0.042*
Waiting for organised vaccination scheme						
—						
Vaccine shortage						

Continued

Table 2 Continued

Item/Characteristics	Equal or under the median score (n (%))	Over the median score (n (%))	Unadjusted		Adjusted	
			OR (95% CI)	P value	OR (95% CI)	P value
Technical title						
Junior	230 (56.10)	180 (43.90)	1	—	1	—
Intermediate	145 (46.18)	169 (53.82)	1.49 (1.11 to 2.00)	0.008*	1.42 (1.04 to 1.94)	0.028*
Associate senior	87 (55.06)	71 (44.94)	1.04 (0.72 to 1.51)	0.824	0.94 (0.64 to 1.38)	0.748
Senior	14 (56)	11 (44)	1.00 (0.45 to 2.26)	0.992	0.83 (0.36 to 1.93)	0.665
Others	42 (46.15)	49 (53.85)	1.49 (0.94 to 2.35)	0.086	1.38 (0.85 to 2.25)	0.197
COVID-19 vaccination						
Vaccinated	402 (50.06)	401 (49.94)	1	—	1	—
Unvaccinated	116 (59.49)	79 (40.51)	0.68 (0.50 to 0.94)	0.019*	0.69 (0.50 to 0.96)	0.026*
Unwillingness to receive COVID-19 vaccine						
Region						
Eastern	195 (62.30)	118 (37.70)	1	—	1	—
Central	132 (54.55)	110 (45.45)	1.38 (0.98 to 1.94)	0.066	1.43 (1.01 to 2.02)	0.045*
Western	270 (60.95)	173 (39.05)	1.06 (0.79 to 1.43)	0.707	1.16 (0.85 to 1.58)	0.346

Unadjusted and adjusted logistic regression analyses were used and variables in univariate analyses including: age, sex, educational levels, specialty, technical titles, years of work experience, economic area locations and introcity locations of their PHC facilities, the highest grade of risk levels the area of PHC facilities ever reached, COVID-19 vaccination status and the subgroup of directors or deputy directors or convenience sample of primary care physicians.
*P<0.05.
PHC, primary healthcare.

coverage was higher in the group of members with higher technical titles. This could be related to the role the PHC facilities are playing as vaccination providers in mainland China, and the critical challenge of COVID-19 pandemic that made the managers of COVID-19 prevention and control team highly aware of the importance in COVID-19 vaccination.

Our findings also indicated that male members of COVID-19 prevention and control management team from PHC facilities were twice as likely to get vaccinated as female members. Similarly, other researchers also described the gender differences in the COVID-19 vaccine acceptance and males had greater acceptability than females.[6 19] The vaccinated rate and willingness difference between genders provide a practical guidance in motivating the PCPs' vaccination.

The adjusted analysis showed that among the team members of group B, those at or under the median age had twice the odds of vaccination coverage compared with those over the median age. Although the specific influence degree remains controversial in several studies,[17 20] different age levels were described to be associated with COVID-19 vaccination acceptance and coverage. What should be noted is that the growing age is also related to a higher infection risk and severity of the disease. The higher risk of SARS-CoV-2 infection in elderly individuals who were over 60 years old has resulted in a higher COVID-19-associated mortality.[21] It should be more important for seniors to be vaccinated against COVID-19 as long as their physical conditions are allowed.

In addition, our study revealed the correlation between specialty and COVID-19 vaccination coverage and attitudes. Team members of COVID-19 prevention and control management from PHC facilities who were specialised in traditional Chinese medicine were less likely to get vaccinated against COVID-19 compared with those who practiced general medicine. Furthermore, those with non-medical titles had nearly twice the chance of giving a higher score of uncertainty of vaccine safety and vaccine efficacy compared with those with junior medical titles. According to the report by Ming-Wei Wang *et al*,[22] the HCWs have a higher vaccination rate and are less hesitant or reluctant on COVID-19 vaccine than non-HCW.[10] All of the evidence above would indirectly suggest that promotion of COVID-19 vaccination programme in public would be a challenge due to the lack of general medical education.

Interestingly, we found that PCPs with a non-medical title were more likely to give a higher score on advice of social sources. Leng *et al* also reported that the vaccination decision making could be driven by the acquaintances' acceptance.[20] General practitioners were trusted in providing vaccine information and promoting vaccine acceptance via specialty consultations.[17] As COVID-19 vaccination providers, it is critical to improve the COVID-19 vaccination awareness in PHCs, especially those who were specialised in traditional Chinese medicine and those with non-medical education backgrounds.

Among group A members of COVID-19 prevention and control management team, the adjusted analysis found that those with college education experiences were less likely to score higher in COVID-19 vaccination importance compared with those with technical secondary school education experiences. Thus, more attention should be paid to those with a higher educational background to emphasise importance of COVID-19 vaccination. This

finding is contrary to a multicentre survey conducted by Janssen *et al* in French healthcare facilities, which showed that vaccine acceptance was growing with educational background.[19] Consistently, our results also revealed that the odds of giving a higher score of uncertainty of vaccine efficacy were quadrupled among team members with graduate school educational backgrounds compared with those with technical secondary school educational backgrounds. Therefore, except for improving their awareness of COVID-19 vaccination importance, the vaccine efficacy deserves a particular scientific focus and make the data available to the public.

In PHC facilities, although there was a higher COVID-19 vaccination coverage among members of COVID-19 prevention and control management team, some subgroups with different descriptive characters showed negative attitudes towards COVID-19 vaccination. Because primary care workers in China are both vaccine receivers and vaccine providers of COVID-19, continuous education efforts are needed to change their attitudes based on the specific influencing factors related to vaccine hesitancy. The findings could also be extended to public vaccination education programme. Despite the fact that so many countries including China have made COVID-19 vaccination programme available to the entire population for several months, especially at no cost to the public in China, the booster shot are still needed and potentially useful due to the emergence of the unpredictable variants of SARS-CoV-2.[11 12] Therefore, it remains very important to make continuous efforts to achieve a satisfactory COVID-19 vaccination coverage.

Limitations

Several possible limitations can be conceived for the present study. First, this research was conducted via the online survey and only the questions on the survey were asked. Second, the respondents were not chosen randomly, which might lead to a selection bias. Other factors such as the doses of vaccination for effective immunity and different vaccine types which might influence the vaccination decisions or cause vaccine hesitancy were not included in the questionnaire because of the relatively earlier time when this survey was conducted.

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Acknowledgements The authors acknowledge and thank all the participants both in the pilot interview and this survey. The authors would like to thank Joint Working Committee of Directors of Community Health Service Centres, Community Health Association of China for supporting the distribution of the questionnaires. The authors would like to thank the Shanghai Pudong New District Shanggang Community Health Care Center, Zhongshan Hospital Fudan University and Affiliated Hospital of Zunyi Medical University for technical support.

Contributors Y-YY did the pilot interview and drafted the questionnaire. H-TW and X-JS assisted in the questionnaire distribution and collection. Y-YY and T-YF did the data extraction and performed statistical analyses. Y-YY created the figures and wrote the manuscript. Z-HD and X-MS contributed to the study design and revised the first version of the manuscript. All authors read the manuscript with an approval. Y-YY and X-MS are responsible for the overall content as the guarantor, accept full responsibility for the design and the conduct of the work, had full access to the data, and controlled the decision to publish.

Funding This study was funded by Pudong New District Health System Medical Discipline Construction Funding and Support (Community Healthcare Demonstration Discipline, PWYsf2021-03), Pudong New District Health System Preponderant Discipline of General Practice (PWYq2020-01) and Pudong New District Health System New Pilot Model of General Practice Service in Traditional Chinese Medicine (PDZY-2020-0703).

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval The study was approved by the Ethics Committee of Pudong Institute for Health Development, Shanghai (registration number: PDWFY2020001). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request.

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