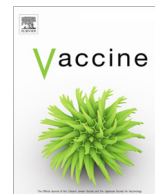




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Willingness to accept a future influenza A(H7N9) vaccine in Beijing, China



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ABSTRACT

Background: The present study aimed to estimate residents' willingness to accept a future H7N9 vaccine and its determinants in the general adult population in Beijing, China.

Methods: We conducted a multi-stage sampling, cross-sectional survey using self-administered anonymous questionnaires from May to June, in 2014. The main outcome variable was residents' willingness to accept a future H7N9 vaccine. Logistic regression was used to identify the predictors of vaccination willingness.

Results: Of the 7264 eligible participants, 14.5% of Beijing residents reported that they had not heard of H7N9. Among those who had heard of H7N9, 59.5% of the general adult population would be willing to accept a future H7N9 vaccine, and approximately half of them reported 'I am afraid of being infected by H7N9' and 'H7N9 vaccine can prevent infections', and 28.1% reported 'my daily life is affected by H7N9'. The variables that were significantly associated with a higher likelihood of reporting willingness were being younger adults (aged 18–29 years: OR = 1.52, 95% CI: 1.17–1.97; aged 30–39 years: OR = 1.39, 95% CI: 1.08–1.78), being farmers (OR = 1.61; 95% CI: 1.32–1.96), being unemployed people (OR = 1.36; 95% CI: 1.04–1.78), living in suburban areas (OR = 2.18; 95% CI: 1.89–2.51), having ≥ 2 children in the family (OR = 1.41; 95% CI: 1.03–1.92), perceived risk in China (OR = 1.30; 95% CI: 1.15–1.48), perceived susceptibility to disease (OR = 3.13; 95% CI: 2.73–3.58), perceived negative effect on daily life (OR = 1.32; 95% CI: 1.13–1.55), perceived effectiveness of vaccination (OR = 2.34; 95% CI: 2.07–2.64), and recent uptake of influenza vaccine (OR = 2.26; 95% CI: 1.92–2.66).

Conclusions: A great number of Beijing residents had doubts about the vaccine's effectiveness and were not concerned about disease risk, which were the factors affecting willingness to be vaccinated. Targeted education programs on disease risk as well as vaccine's effectiveness are needed to improve the willingness of vaccination for potential H7N9 pandemic preparedness.

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1. Introduction

Avian influenza A (H7N9) virus was first identified as a novel virus in Eastern China in March 2013 [1]. Global attention was soon focused on the situation because of the increasing number of new cases and the high rate of death associated with the infections [2]. As of February 23, 2017, a total of 1220 human infections with the virus, including 494 deaths, have been reported from mainland

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China during the former four epidemics [3]. Current evidence suggests that this virus has not acquired the ability of sustained transmission among humans, but small clusters of infected cases involving healthcare workers have been observed previously [4]. Phylogenetic analyses have suggested there is a possible pandemic threat from new reassortment of influenza A (H7N9) virus, emphasizing the importance of continuous surveillance and protective measures against epidemic spread [5].

Vaccination remains one of the most effective strategies in controlling epidemics, but promoting the vaccination uptake can be a difficult challenge for local governments [6]. WHO has recommended several candidate vaccine viruses for the development of H7N9 vaccines for the purpose of pandemic preparedness [7]. Although up to now (as of August 2017), no H7N9 vaccines are commercially available [8], a phase I/II trial suggests that the H7N9 influenza vaccine was immunogenic and safe in adults [9]. Therefore, vaccination is a critical part of H7N9 pandemic preparedness.

Beijing had a heavy burden of Severe Acute Respiratory Syndromes (SARS) in 2003 and pandemic influenza A (H1N1) in 2009 [10]. During the 2009 H1N1 pandemic, pandemic influenza vaccination was first provided to priority populations (e.g., older adults, public servants in key positions, students, teachers and people with chronic diseases) and then other persons in Beijing, and it was proven to be an effective strategy in controlling epidemics [11]. Our previous study showed the vaccination coverage rate was relatively low within the general adult population of Beijing, and the perceptions of not expecting to contract influenza was the predominant barrier to influenza vaccination [12]. Although Beijing has only reported 37 laboratory-confirmed cases of influenza A (H7N9) and 11 deaths as of August 2017, a potential threat of H7N9 pandemic has always been in Beijing. Therefore, preventive measures, including pandemic vaccination policy, should be prepared for possible H7N9 pandemic. Understanding the willingness to accept a future H7N9 vaccine and its main related factors may enable policy makers to take measures for future vaccination coverage improvement. Although several surveys have been conducted in Southern China [13–15], only one of these studied a general population while the other two focused on food producers or live poultry traders. Considering the diverse epidemic strength [16], income levels and healthcare access across China, public willingness to accept a future H7N9 vaccine may vary by region. In the present study, we conducted a large population-based cross-sectional survey to estimate residents' willingness to accept a future H7N9 vaccine and to identify its associated possible factors in the general adult population of Beijing at the end of the second epidemic wave.

2. Materials and methods

2.1. Study area

Beijing is the capital of China and the largest city in Northern China. It is divided into 16 districts, which are classified as urban and suburban districts according to the population density and local economic level. As of the 2010 census, the city had a population of nearly 20 million [17].

2.2. Participants and survey design

The target population was Chinese adults living in Beijing. The participants were classified into ten subgroups according to residence (urban or suburban) and different age groups (18–29, 30–39, 40–49, 50–59 and ≥ 60 years). The formula $n = \mu_2^2 \times \pi \times (1 - \pi) / \delta^2 \times \text{deff}$ was used to estimate the sample size per subgroup, based on an α error of 5%, the rate of residents' willingness

to accept a future H7N9 vaccine in the general population of Beijing (π) = 50%, maximum permissible error (δ) = 0.1π , and the design effect of complex sampling (deff) = 1.5 [18,19]. We estimated a sample size of 576 participants per subgroup. Regarding 10 subgroups, a no-answer rate of 15% and a rate of 10% participants who had not heard of H7N9, the optimal sample size for the present study was 7286 (576 participants per subgroup \times 10 subgroups \times 1.15 \times 1.1).

In this study, participants were recruited by a multistage stratified sampling approach [18–20]. Initially, three urban districts and three suburban districts were randomly selected to be sampled. From each selected district, five towns or streets were randomly selected. And then five communities or villages were randomly selected in each of these towns or streets. In total, 150 committees or villages were confirmed as the survey locations. To meet the sample size requirement, about 48 participants (about 10 participants in each age group) needed to be selected from each survey location.

2.3. Data collection

We conducted the survey from May to June, in 2014, at the end of the second epidemic wave of H7N9. Within each survey location, all the households were randomly numbered according to the address numbers. Well-trained interviewers from local Centers for Disease Prevention and Control visited the households individually according to the random numbers, and interviewed each adult within the households until a total of 48 residents and about 10 participants per age group were investigated in each survey location. Because the family size of Beijing residents was ranged from 2 to 3, approximately 16 to 24 households were randomly selected for interview. Before visiting a household, they made an appointment with the family. If all the residents in a household were not available for the first visit, re-visits would be made to the household. During the interviews, participants were asked to complete the questionnaire by themselves or with the help of interviewers if they had difficulty with reading or writing.

The survey was carried out using a self-administered, anonymous questionnaire, which consisted of four sections: (1) Demographics information (gender, age, educational level, employment status, living area and number of children within the family); (2) Have you ever heard of avian influenza A (H7N9)? The response options were 'yes' and 'no'. If the response was 'no', the following questions from Sections 3 and 4 were not required to answer. (3) Residents' willingness to accept a future H7N9 vaccine if it is available with the response options of 'yes' and 'no'; and (4) Residents' perceptions regarding H7N9 listed as follows: 'H7N9 will remain in China'; 'H7N9 is a serious disease'; 'I am afraid of being infected by H7N9'; 'My daily life is affected by H7N9'; 'H7N9 vaccine can prevent infections' and 'I have accepted the seasonal influenza vaccine in the past year'. The six questions were close-ended, and the response options were 'yes' and 'no'. All the questions were based on evidence in the existing literature [21].

2.4. Ethics statement

The study approval was obtained from the Institutional Review Board and Human Research Ethics Committee of Beijing Center for Disease Prevention and Control (approval number: 2013-11, approval date: December 10, 2013). Anonymity of the participants was guaranteed to participants, and agreement and informed consent from participants was required during the surveys.

2.5. Statistical analysis

The main outcome variable was residents' willingness to accept a future H7N9 vaccine. Weighted analysis was conducted to

calculate the standardized proportion of people who would be willing to accept a future H7N9 vaccine, accounting for age and living area (urban or suburban) in Beijing population, as reported in the 2010 Census of Beijing [17]. Descriptive analyses were initially performed to generate frequency distributions of the survey variables. Differences among the subgroups were tested by Pearson's Chi-square test. Logistic regression models were then performed to examine the factors associated with residents' willingness to accept a future H7N9 vaccine. Demographic characteristics of participants and residents' perceptions regarding H7N9 were included as the independent variables. Adjusted odds ratios with 95% confidence intervals (95% CI) for the variables were calculated. All the statistical tests were two-sided, with p value <0.05 considered to be statistically significant. All the statistical analyses were carried out using SPSS Version 20.0 (IBM Corporation, New York, United States).

3. Results

3.1. Demographic characteristics of participants

Fig. 1 shows the framework for sample selection. In total, 7264 of the 7369 participants that we approached completed the survey, yielding a response rate of 98.6%. Of the 7264 eligible participants, 1054 (14.5%) participants who had not heard of H7N9 were excluded from the analysis of willingness to accept H7N9 vaccine. Finally, a total of 6210 participants who had heard of H7N9 were included in the further analysis of willingness to be vaccinated.

Approximately half of the total participants were female ($n = 3680$) and lived in urban areas ($n = 3576$). The distribution of age was as follows: 18–29: 20.5% ($n = 1487$), 30–39: 19.9% ($n = 1440$), 40–49: 20.5% ($n = 1488$), 50–59: 19.8% ($n = 1432$), ≥ 60 : 19.3% ($n = 1399$). Participants who had not heard of H7N9 tended to be farmer, were older, and had lower education than those who had heard of H7N9 (Table 1).

3.2. Weighted proportions of participants who would be willing to accept a future H7N9 vaccine

After being standardized for age and living area, 59.5% of the general adult population would be willing to accept a future H7N9 vaccine. The standardized proportions were 59.4%, 60.4%, 57.1%, 60.7% and 60.0% in the five age groups (18–29, 30–39, 40–49, 50–59 and ≥ 60 years), respectively. Regarding the comparison between living areas, the proportions were 50.7% and 72.7% among urban and suburban residents, respectively.

3.3. Perceptions regarding influenza A (H7N9) among participants who had heard of H7N9

Table 2 shows perceptions regarding influenza A (H7N9). A total of 5043 (81.3%) participants reported 'H7N9 is a serious disease', 4118 (66.5%) reported 'H7N9 will remain in china', and approximately half reported 'I am afraid of being infected by H7N9' ($n = 3120$) and 'H7N9 vaccine can prevent infections' ($n = 2887$). Only 28.1% of participants reported 'My daily life is affected by H7N9' ($n = 1741$).

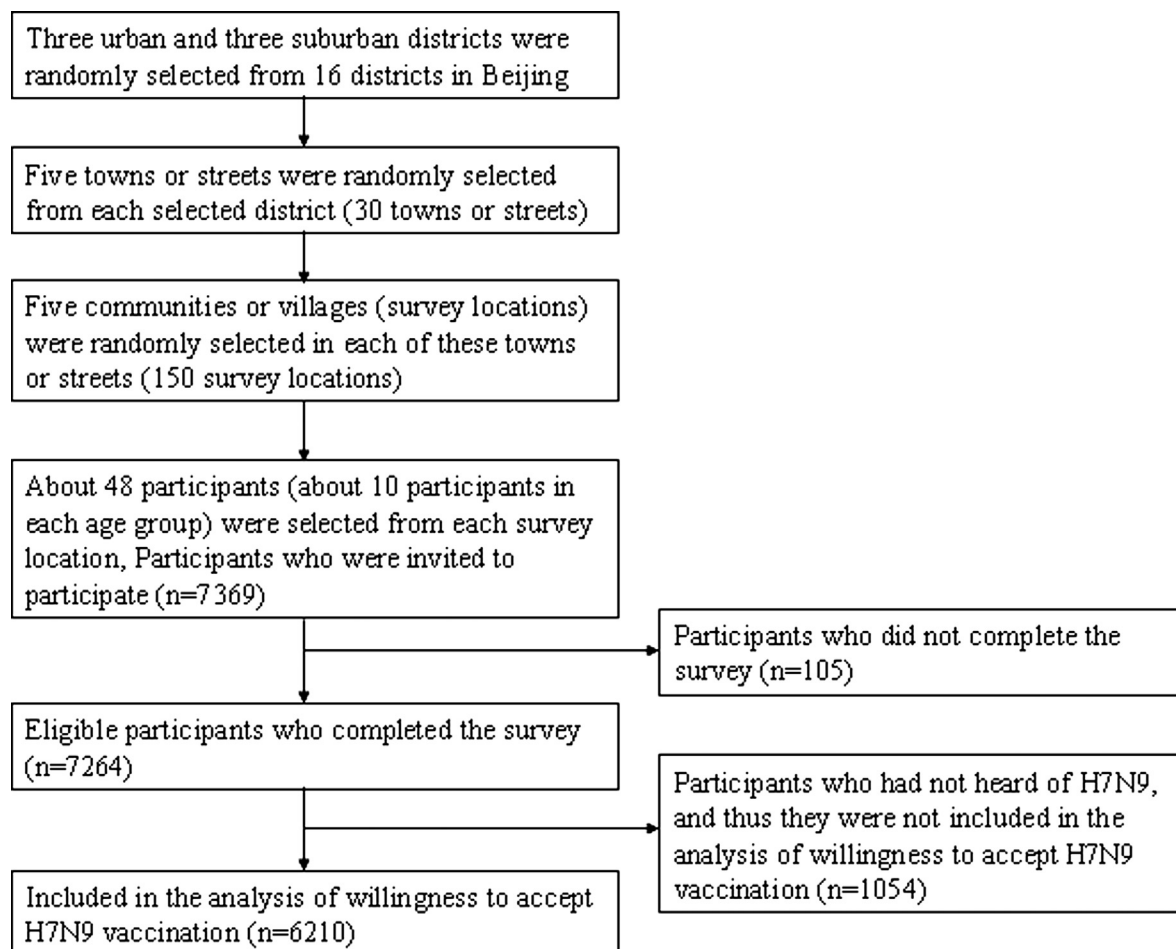


Fig. 1. Sample section framework.

Table 1
Demographic characteristics of the participants for surveys of willingness to accept a future influenza A (H7N9) vaccine in Beijing, China.

Characteristic	Total participants (N = 7264)		Participants who had heard of H7N9 (N = 6210)		Participants who had not heard of H7N9 (N = 1054)		Chi-square value	P value
	n	%	n	%	n	%		
Gender							0.1	0.711
Female	3680	50.7	3156	50.9	524	49.8		
Male	3579	49.3	3050	49.1	529	50.2		
Missing	5		4		1			
Age (years)							67.8	<0.001
18–29	1487	20.5	1280	20.7	207	19.7		
30–39	1440	19.9	1275	20.6	165	15.7		
40–49	1488	20.5	1310	21.1	178	16.9		
50–59	1432	19.8	1226	19.8	206	19.6		
≥60	1399	19.3	1104	17.8	295	28.1		
Missing	18		15		3			
Highest education							225.8	<0.001
Illiterate	167	2.3	105	1.7	62	5.9		
Primary school	599	8.3	432	7.0	167	15.9		
Junior high school	1898	26.2	1568	25.3	330	31.5		
Senior high school	2203	30.4	1942	31.4	261	24.9		
3-year college graduate or higher	2372	32.8	2143	34.6	229	21.8		
Missing	25		20		5			
Occupation							96.8	<0.001
Other employees ^a	3434	47.3	3037	49.0	397	37.7		
Students	266	3.7	221	3.6	45	4.3		
Farmers	1968	27.1	1577	25.4	391	37.1		
Healthcare workers	169	2.3	166	2.7	3	0.3		
Retirees	982	13.5	842	13.6	140	13.3		
Unemployed people	438	6.0	360	5.8	78	7.4		
Missing	7		7		0			
Living area							3.3	0.071
Urban	3576	49.2	3030	48.8	546	51.8		
Suburban	3688	50.8	3180	51.2	508	48.2		
Numbers of children							7.1	0.029
0	4021	56.1	3408	55.5	613	59.7		
1	2838	39.6	2470	40.2	368	35.8		
≥2	310	4.3	264	4.3	46	4.5		
Missing	95		68		27			

Note: "Missing" indicates the number of respondents who did not answer this question.

^a Other employees: factory workers, government employees, and employees from business and service industry.

Table 2
Perceptions regarding influenza A (H7N9) among the participants who had heard of H7N9 in Beijing, China.

Perceptions	n	%
H7N9 will remain in china (perceived risk in China)		
No	2070	33.5
Yes	4118	66.5
Missing	22	
H7N9 is a serious disease (perceived severity of disease)		
No	1157	18.7
Yes	5043	81.3
Missing	10	
I am afraid of being infected (perceived susceptibility to disease)		
No	3086	49.7
Yes	3120	50.3
Missing	4	
My daily life is affected by H7N9 (perceived negative effect on daily life)		
No	4460	71.9
Yes	1741	28.1
Missing	9	
H7N9 vaccine can prevent infections (perceived effectiveness of vaccination)		
No	3293	53.3
Yes	2887	46.7
Missing	30	

Note: Missing referred to "how many people did not answer this question".

3.4. Logistic regression analysis for factors associated with residents' willingness to accept a future H7N9 vaccine

As shown in Table 3, after adjustment for the potential confounding variables, the variables that were significantly associated with a higher likelihood of reporting willingness to accept a future H7N9 vaccine were being younger adults (aged 18–29 years: OR = 1.52, 95% CI: 1.17–1.97; aged 30–39 years: OR = 1.39, 95% CI: 1.08–1.78), being farmers (OR = 1.61; 95% CI: 1.32–1.96), being unemployed people (OR = 1.36; 95% CI: 1.04–1.78), living in suburban areas (OR = 2.18; 95% CI: 1.89–2.51), having ≥2 children in the family (OR = 1.41; 95% CI: 1.03–1.92), perceived risk in China (OR = 1.30; 95% CI: 1.15–1.48), perceived susceptibility to disease (OR = 3.13; 95% CI: 2.73–3.58), perceived negative effect on daily life (OR = 1.32; 95% CI: 1.13–1.55), perceived effectiveness of vaccination (OR = 2.34; 95% CI: 2.07–2.64), and recent uptake of influenza vaccine (OR = 2.26; 95% CI: 1.92–2.66).

4. Discussion

High population density makes Beijing easy to be threatened by pandemics of SARS, influenza, and other emerging respiratory infectious diseases. In this cross-sectional study, we found that a large proportion (14.5%) of Beijing residents had not even heard of H7N9 at the end of the second epidemic wave. Unlike the unforgettable experience of SARS in 2003, the emergence of H7N9 had

Table 3

Logistic regression analysis for the factors associated with residents' willingness of influenza A (H7N9) vaccine uptake in Beijing, China.

Variables	Willingness to take H7N9 vaccine in the future				
	%(n/N)	Unadjusted OR (95% CI)	P value	Adjusted OR (95% CI)	P value
<i>Gender</i>					
Female	63.4(2000/3156)	1.13(1.02–1.25)	0.020	1.09(0.96–1.22)	0.175
Male	60.5(1845/3050)	1.00(referent)		1.00(referent)	
<i>Age (years)</i>					
18–29	62.4(799/1280)	1.00(0.84–1.18)	0.969	1.52(1.17–1.97)	0.001
30–39	62.4(796/1275)	1.00(0.84–1.18)	0.972	1.39(1.08–1.78)	0.012
40–49	59.8(784/1310)	0.89(0.76–1.05)	0.183	1.11(0.87–1.40)	0.400
50–59	63.1(773/1226)	1.02(0.87–1.21)	0.784	1.22(0.99–1.51)	0.061
≥60	62.5(690/1104)	1.00(referent)		1.00(referent)	
<i>Highest education</i>					
Illiterate	71.4(75/105)	1.00(referent)		1.00(referent)	
Primary school	71.3(308/432)	0.99(0.62–1.59)	0.979	1.13(0.66–1.92)	0.653
Junior high school	67.6(1060/1568)	0.83(0.54–1.29)	0.417	1.22(0.74–2.01)	0.443
Senior high school	62.0(1204/1942)	0.65(0.42–1.01)	0.053	1.13(0.68–1.88)	0.635
3-year college graduate or higher	55.8(1196/2143)	0.51(0.33–0.78)	0.002	1.11(0.66–1.86)	0.700
<i>Occupation</i>					
Other Employees ^a	57.2(1738/3037)	1.00(referent)		1.00(referent)	
Students	56.1(124/221)	0.96(0.73–1.26)	0.746	0.73(0.53–1.02)	0.068
Farmers	76.0(1198/1577)	2.36(2.06–2.71)	<0.001	1.61(1.32–1.96)	<0.001
Healthcare workers	60.8(101/166)	1.16(0.84–1.60)	0.359	1.05(0.74–1.51)	0.775
Retirees	53.6(451/842)	0.86(0.74–1.00)	0.058	0.94(0.75–1.19)	0.612
Unemployed people	65.3(235/360)	1.41(1.12–1.77)	0.004	1.36(1.04–1.78)	0.025
<i>Living area</i>					
Urban	50.7(1537/3030)	1.00(referent)		1.00(referent)	
Suburban	72.7(2312/3180)	2.59(2.33–2.88)	<0.001	2.18(1.89–2.51)	<0.001
<i>Numbers of children</i>					
0	62.6(2134/3408)	1.00(referent)		1.00(referent)	
1	60.2(1488/2470)	0.90(0.81–1.01)	0.065	0.93(0.82–1.06)	0.258
≥2	71.2(188/264)	1.48(1.12–1.94)	0.006	1.41(1.03–1.92)	0.030
<i>H7N9 will remain in China (perceived risk in China)</i>					
No	55.4(1146/2070)	1.00(referent)		1.00(referent)	
Yes	65.4(2693/4118)	1.52(1.37–1.70)	<0.001	1.30(1.15–1.48)	<0.001
<i>H7N9 is a serious disease (perceived severity of disease)</i>					
No	53.7(621/1157)	1.00(referent)		1.00(referent)	
Yes	63.9(3222/5043)	1.53(1.34–1.74)	<0.001	1.03(0.88–1.20)	0.731
<i>I am afraid of being infected (perceived susceptibility to disease)</i>					
No	47.5(1467/3086)	1.00(referent)		1.00(referent)	
Yes	76.3(2381/3120)	3.56(3.19–3.96)	<0.001	3.13(2.73–3.58)	<0.001
<i>My daily life is affected by H7N9(perceived negative effect on daily life)</i>					
No	55.3(2467/4460)	1.00(referent)		1.00(referent)	
Yes	79.1(1377/1741)	3.06(2.68–3.48)	<0.001	1.32(1.13–1.55)	0.001
<i>H7N9 vaccine can prevent infections (perceived effectiveness of vaccination)</i>					
No	50.7(1670/3293)	1.00(referent)		1.00(referent)	
Yes	74.9(2163/2887)	2.90(2.61–3.24)	<0.001	2.34(2.07–2.64)	<0.001
<i>Uptake of influenza vaccine in the past year</i>					
No	59.0(2885/4889)	1.00(referent)		1.00(referent)	
Yes	73.1(958/1311)	1.89(1.65–2.16)	<0.001	2.26(1.92–2.66)	<0.001

Note: CI = Confidence Intervals, OR = Odds Ratio.

^a Other employees: factory workers, government employees, and employees from business and service industry.

not caused public panic yet; a previous study also showed this result [22]. In addition, a study in China showed that the experience of H1N1 pandemic in 2009 did not also result huge in society [23]. This may be explained by the great progress in the mechanism for emergency responses to emerging infectious diseases after the SARS outbreak in China. The current mechanism allowed China to successfully deal with the subsequent H1N1 pandemic and H7N9 epidemics [24].

In a public health emergency, pandemic vaccination remains one of the most effective strategies in controlling epidemics, but promoting the vaccination uptake can be a difficult challenge for local governments [6]. In this study, 59.5% of the general adult population who had heard of H7N9 would like to accept H7N9 vac-

ination in the future. Our estimate was comparable to that of Hong Kong during the epidemic of H7N9 (50.5%) [13]. However, previous studies have shown that residents' willingness of future H7N9 influenza vaccine uptake varied across different regions and sub-populations: 50.5% among the general population of Hong Kong, 84% among the employees of food production of Guangzhou and 42.2% among live poultry traders of Guangzhou, a city located in Southern China [13–15]. Our estimate during the epidemic of H7N9 was also consistent with some findings from a systematic review during the 2009 H1N1 pandemic [25] (56.1% in the United Kingdom [26], 64% in the United States [27] and 54.7% in Australia [28]). Moreover, the systematic review found that there was a lot of variation (8.7–67%) in respondents' willingness to accept

H1N1 pandemic vaccine across the ten studies [25]. Factors thought to contribute to willingness to receive the H1N1 pandemic vaccine included personal risk perception, vaccination attitude, communications and information sources, access and demographic variables [25].

The present study only estimated the willingness to be vaccinated, but not actual vaccination. Most estimates of vaccination intention tend to be much greater than actual vaccine coverage estimates during the 2009 H1N1 pandemic [29]. Although the Beijing government launched mass vaccination campaigns during the second wave of the pandemic, the influenza vaccination coverage rates were relatively low (21.8%) and did not increase significantly during the 2009 H1N1 pandemic [12]. For the above reasons, we can infer that the actual coverage of H7N9 vaccination will be much lower than our estimate of 59.5% in emergency mass-vaccination campaigns during an emergency.

In this study, we found that younger adults, farmers, people waiting for employment and people living suburban areas reported more willingness to be vaccinated than others. In China, these people are more likely to expose to live poultry including raising backyard poultry and visiting poultry market, and thus perceive higher risk of H7N9 infections [30], which may promote their willingness to accept a future H7N9 vaccine. Consistent with the results of our study, a study conducted during the 2009 H1N1 pandemic suggested that a higher intention to accept future vaccination was observed in families with the presence of children, which may be explained by a higher level of concern about pandemic influenza [31].

Our results demonstrated many related factors including severity of the public event, risk of infection, severity of disease, vaccination effectiveness and acceptance of previous vaccination, were predictors of the intention to be vaccinated, and the result is consistent with the previous studies [28,29,32,33]. In this study, only half of participants reported 'I am afraid of being infected by H7N9' and 'H7N9 vaccine can prevent infections', and 28.1% reported 'my daily life is affected by H7N9'. The results showed that a large part of people in Beijing had doubts about the vaccine's effectiveness and were not concerned about disease risk, which would lead to less willingness to accept H7N9 vaccination. Therefore, targeted education programs on disease risk as well as vaccine's effectiveness would be an effective strategy to help people make informed vaccination decisions.

The present study has some limitations. First, as a cross-sectional study using a self-administered questionnaire, self-reported data may have introduced information bias in data collection. Second, the current study did not include 'I do not know' option, which could also lead to information bias. Nevertheless, a large proportion of the participants who had not heard of H7N9 and thus more likely to report 'I do not know' option were not included in the analysis of willingness to accept a future H7N9 vaccine. In addition, during the survey, very few participants asked the interviewers whether there was an 'I do not know' option. Thus, we believed that the participants who might otherwise have chosen 'I do not know' accounted for only a small proportion, if any, of the total participants. Third, because the households but not individuals were selected at random in this study, the statistical effect of this further clustering would be to increase design effect and result in inappropriately narrow confidence intervals. Fourth, the rates for uptake willingness may differ from season to season because of changing conditions such as mortality rates and epidemic strength, which suggests the need for continued monitoring in Beijing. Finally, the findings of this study are representative at the level of Beijing, perhaps Northern China, but considering the diverse epidemic strength, income levels and healthcare access across regions, our observations might not be generalized well to other countries or regions.

5. Conclusions

This study demonstrated that there was a large proportion (14.5%) of Beijing residents who had not heard of H7N9. Among those who had heard of H7N9, 59.5% of the general adult population would be willing to accept a future H7N9 vaccine in the future, and a large proportion of them had doubts about the vaccine's effectiveness and were not concerned about disease risk, which were the factors affecting residents' willingness to accept H7N9 vaccination. Therefore, health education programs targeted at increasing public perceptions towards disease risk and vaccine's effectiveness are warranted to improve the willingness of vaccination for potential H7N9 pandemic preparedness.

Authors' contributions

Designed the study: WS, SJ, YP, WQ. Performed the data collection: WS, SJ, ZH, LH, CY, HW, LC, TY. Analyzed the data: WS, SJ. Drafted the manuscript: WS. Revised the manuscript: WS, SJ, YP, WQ. All authors have read and approved the final version of the manuscript.

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Disclaimers

The opinions expressed by authors contributing to this journal do not necessarily reflect the opinions of the institutions with which the authors are affiliated.

Competing interests

The authors declare that they have no competing interests.

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