BMJ Open

# Willingness to vaccinate against herpes zoster in Chinese urban population: a mixed-methods study

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**To cite:** Wang M, Hu M, Wang Y, *et al*. Willingness to vaccinate against herpes zoster in Chinese urban population: a mixed-methods study. *BMJ Open* 2023;**13**:e079115. doi:10.1136/bmjopen-2023-079115

► 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-2023-079115).

Received 22 August 2023
Accepted 09 November 2023



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## ABSTRACT

**Objective** Although the herpes zoster vaccine has been available in mainland China since June 2020, residents' knowledge of herpes zoster and the herpes zoster vaccine is poor, and vaccination rates are low, especially among the elderly, who are at high risk for herpes zoster. This study assessed willingness to be vaccinated against herpes zoster and factors associated with vaccination among urban residents in China.

**Methods** A mixed-methods study was conducted in community health centres from August 2022 to September 2022. We used convenience sampling to select 2864 residents from 9 Chinese cities for the quantitative study and 67 adults for the qualitative study. A structured questionnaire was used for the quantitative study, and data were collected through face-to-face interviews. Multinomial logistic regression was used to analyse factors associated with willingness to vaccinate. Qualitative data were analysed using thematic analysis of barriers to herpes zoster vaccination.

**Results** A total of 2864 eligible respondents were included in the study. Of these, 42.67% intended to receive the herpes zoster vaccine, 21.44% refused and 35.89% were hesitant. The results of the quantitative and qualitative analyses showed that the factors associated with respondents' willingness to be vaccinated against herpes zoster included: personal characteristics such as gender, age and income; knowledge and attitudes about herpes zoster and the vaccine; vaccine characteristics such as efficacy, safety and price; and other factors such as pain tolerance and accessibility to vaccination.

**Conclusion** The low willingness to vaccinate, especially among the elderly, is mainly related to their poor knowledge and negative attitude towards the infection and vaccination. Therefore, health education about herpes zoster, immunisation promotion, and improvement of accessibility and affordability would be valuable in China.

## STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Our mixed-methods, theory-driven approach will contribute to a more comprehensive and holistic understanding of barriers and facilitators to herpes zoster vaccination than single-method, non-theory-driven approaches.
⇒ The study included a large number of respondents of different genders and ages, allowing us to obtain information on gender and age differences in willingness to receive herpes zoster vaccination.
⇒ The quantitative survey was not a random sample.
⇒ Respondents were recruited from community health centres, which may be more health conscious, and therefore, have better access to information and vaccines, which may overestimate the results of vaccination willingness and not be representative of the general population.

## INTRODUCTION

Herpes zoster is an infectious disease caused by the reactivation of the varicella-zoster virus that has been latent in the ganglia for a long time. Clinically, it presents as a unilateral blister-like rash characterised by confinement to a single skin area, usually accompanied by nerve root pain.[1 2] The clinical presentation and course of herpes zoster also varies depending on the patient's age, health status and immune status, and is more common and severe in the elderly and immunocompromised populations.[3 4] The lifetime risk of herpes zoster ranges from 25% to 30%, rising to 50% in people over 80 years of age.[5] The global incidence of herpes zoster in the general population is (3–5)/1000 person-years, the incidence of herpes zoster over 60 years of age is (6–8)/1000 person-years and can reach (8–12)/1000 person-years over 80 years of age.[6] A study investigating people over 50 years of age in China showed that the overall incidence of herpes zoster was 6.64/1000 person-years.[7] The incidence of herpes zoster continues to rise, imposing a heavy disease burden on society and patients.[6] In the USA, the total cost of medical care and lost productivity due to herpes zoster is estimated to be more than US$2 billion per year, along with a high psychosocial burden, resulting in more than 60 000 Quality-Adjusted Life Year (QALYs) lost per year.[8] In China, it is estimated that there are 1 563 000 new cases of herpes zoster each year, at an annual cost of more than CNY1.3 billion.[9]

Vaccination is the best option to prevent herpes zoster.[4 10 11] Studies have shown that vaccination against herpes zoster is cost-effective.[12] The current worldwide licensed vaccines for the prevention of herpes zoster include two main types: zoster vaccine live (ZVL) and recombinant zoster vaccine (RZV), where RZV is one dose and ZVL is two doses, studies have shown that RZV is related to a good profile in terms of tolerability and safety and shows a better profile in terms of protection and duration of the same in respect to ZVL.[13] China approved RZV to prevent herpes zoster in 2019, and eligible people can receive the vaccination at their own expense.[14] However, RZV has yet to be widely promoted. Few studies have reported on the vaccination willingness of the Chinese population for the herpes zoster vaccine, and the results vary widely.[15 16]

Previous studies have found that a variety of factors may influence vaccination willingness of herpes zoster vaccine, such as age, gender, income, previous vaccination experience and perception. However, many studies were based on quantitative analysis only, could not explore the causes in-depth and the representation of survey respondents was limited.[15–18] Therefore, we conducted a mixed-method national survey of adults in nine cities in China during August and September 2022 to investigate vaccination willingness and determinants of vaccination, in order to provide a theoretical basis for the development of herpes zoster promotion and vaccination strategies.

## METHODS

Researchers used a parallel convergent mixed-methods analysis design,[19] with quantitative (QUAN) and qualitative (QUAL) chains implemented simultaneously with equal weighting (QUAN+QUAL).[20] Quantitative and qualitative data were collected and analysed separately. Results were then paired side by side for comparison and to identify convergence and divergence between the two methods (see figure 1). A mixed-methods design facilitated a deeper understanding of the research questions than if quantitative or qualitative methods were used separately.[19]

### Sample/participants

#### Quantitative sample/participants

From August to October 2022, 36 community service centres from 9 cities in China participated in a cross-sectional study on the perceptions, attitudes and needs of herpes zoster and its vaccine. Sampling was done by convenience sampling: (1) first, nine cities were selected across China, including Beijing, Wuhan, Changchun, Weifang, Zhengzhou, Shaoxing, Shenzhen, Nanning and Zunyi; (2) second, one developed and one less developed region were selected in each city and (3) finally, two community service centres were selected within each area, and at least 65 residents aged 25 and above were selected and invited to participate in our survey. A total of 2864 participants were included in our study. Eligibility criteria were: aged 25 and above, not admitted to a care facility, residing in the case study area and demonstrating the cognitive ability to participate in the interview.

#### Qualitative sample

The qualitative part used a convenience sampling method, and three cities with different levels of economic development were selected as survey sites, including Beijing, Shandong and Guangxi. The study population was urban residents aged 25 and above. Recruitment and interviews continued until 'saturation'[21] (ie, no new information was obtained from the interviews). A total of 4 focus group discussions and 46 in-depth interviews were organised for a total of 67 surveys.

### Patients and public involvement

Neither patients nor the public was involved in the study.

### Data collection

#### Quantitative data collection

For the quantitative component, a closed, structured, cross-sectional questionnaire was developed and validated by experienced experts in the field (see online supplemental appendix). The questionnaire had four components: sociodemographic and health status, knowledge about herpes zoster and herpes zoster vaccine, attitudes, and vaccination willingness. In the first part, participants were asked about sociodemographic and health characteristics, such as gender, age, education, occupation and annual household income in 2021. Participants also reported whether they had a history of underlying diseases, such as hypertension, diabetes, cardiovascular disease and cerebrovascular disease, which might make them clinically susceptible to herpes zoster. The second part assesses knowledge of herpes zoster and herpes zoster vaccine through 10 knowledge-based questions adapted from a similar study conducted in Hong Kong.[22] In the third section, participants provided information on their beliefs and attitudes about herpes zoster vaccination, reporting their agreement with 15 items on a 5-point scale. Attitudes were measured based on the '5C' model of vaccine hesitation developed by Betsch *et al*,[23] which measures participants' confidence (eg, vaccine safety, efficacy), complacency (risk perception), constraint (barriers to vaccination), calculation (weighing the pros and cons of vaccination)) and collective responsibility (desire to protect the collective). In part IV, willingness to receive the herpes zoster vaccine was the primary outcome variable. Participants were asked whether they would be willing to receive herpes zoster vaccination in the future and were divided into three groups based on the results: 'yes', 'no' and 'not sure'. Finally, multiple response factors influencing willingness to receive herpes zoster vaccine were also assessed.

After written informed consent was obtained, trained medical student surveyors administered face-to-face surveys to 2864 urban residents. Automated

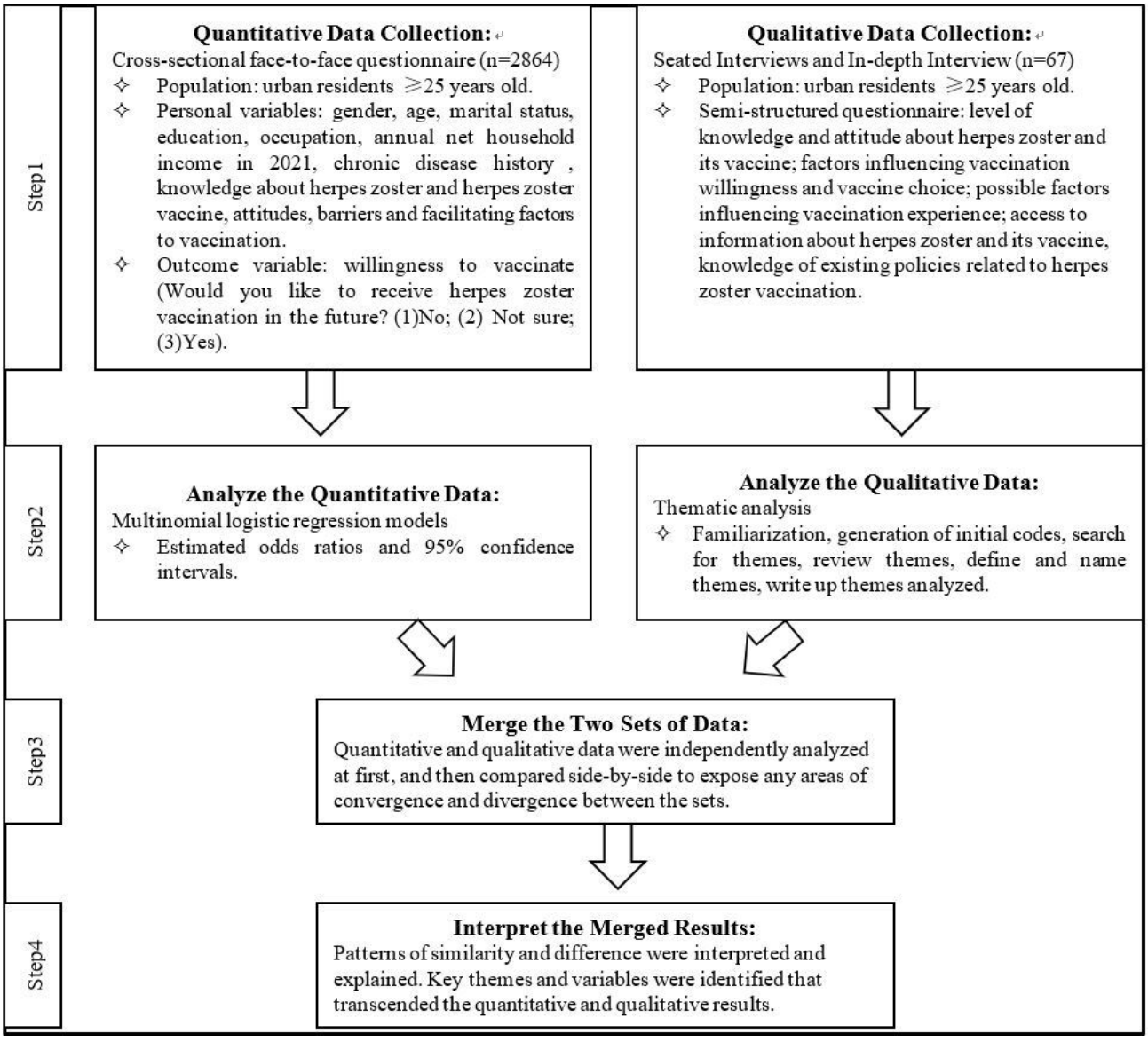


**Figure 1** Parallel convergent mixed-methods model.

logic checks were programmed to reduce input errors and missing values, and individual questionnaires were uploaded and spot-checked for quality control.

### Qualitative data collection

For the qualitative component, researchers conducted in-depth interviews and organisational group discussions using the in-depth interview guide. Before the start of the survey, each respondent provided verbal consent, which was recorded. The researchers developed the in-depth interview guide and validated it with experts in the field. The guide was pilot tested with five adults before the formal survey to ensure comprehensibility, and minor language changes were made. Interviews were audiorecorded and transcribed verbatim. Chinese interviews were translated into English and back-translated to ensure consistency of translation.

## Data analysis

### Quantitative data analysis

Descriptive statistics for the quantitative component were expressed as means, SD, frequencies and percentages. Respondents' sociodemographic characteristics, knowledge, attitudes, vaccination willingness and barriers were assessed with descriptive statistics. Knowledge scores were categorised as below or above the mean. Below-average knowledge scores were considered poor knowledge, and above average were considered good knowledge. Similarly, the attitude scores were categorised as below or above average; below average was considered a negative attitude, and above average was considered a positive attitude.

As the willingness to vaccinate was coded in three levels, a multinomial logistic regression was used to investigate the determinants of the willingness to vaccinate, with the 'no' as the reference group. Variables

with a p<0.25 in bivariate analysis were considered for multivariate analysis. The explanatory variables entered into the multivariate model included age, education, annual net household income in 2021, history of chronic disease, knowledge and attitude. Variables with a p<0.05 were considered to be statistically significant. Data analysis was performed by using STATA V.17.0.

### Qualitative data analysis

NVivo V.12 software was used to conduct a thematic analysis of the interview results. The analysis process included: (1) transcribing the collected audio files and reading them twice to become familiar with the audio content; (2) exploratory creation of analysis nodes to encode the audio files to cluster similar codes; (3) distillation of relevant themes from the created codes and (4) writing a summary of each theme content with representative quotations.

### Mixed-method analysis

Various methods exist for integrating data in mixed-methods studies. In this study, results were paired side by side to compare and identify areas of convergence and divergence after an independent analysis of quantitative and qualitative data. Findings and conclusions from the quantitative and qualitative groups were combined during the discussion and conclusion to enhance our understanding of barriers to herpes zoster vaccination among urban residents.

## RESULTS

### Quantitative results

#### Sociodemographic characteristics

A total of 2864 respondents completed the questionnaire (see table 1). Most respondents were female (60.96%) and married (86.00%). The mean (±SD) age of the respondents was 48.14 years (±16.55), ranging from 25 to 95 years. Education and annual household income in 2021 were evenly distributed, and the occupation was predominantly manual labour (36.77%). The majority (77.65%) had no history of underlying diseases.

**Table 1** Sociodemographic characteristics of the study participants

| | Frequency (N ) | % |
|---|---|---|
| Gender | | |
| Female | 1746 | 60.96 |
| Male | 1118 | 39.04 |
| Age group | | |
| 25–39 | 1114 | 38.90 |
| 40–59 | 929 | 32.44 |
| 60 and above | 821 | 28.66 |
| Marital status | | |
| Unmarried | 252 | 8.80 |
| Married | 2463 | 86.00 |
| Divorced or widowed | 149 | 5.20 |
| Education | | |
| Primary and below | 537 | 18.75 |
| Middle school | 588 | 20.53 |
| High school | 581 | 20.29 |
| College | 452 | 15.78 |
| Bachelor's degree and above | 706 | 24.65 |
| Occupation | | |
| Manual labourer | 1053 | 36.77 |
| Retiree | 613 | 21.40 |
| Unemployed | 463 | 16.17 |
| Professional | 735 | 25.66 |
| Annual household income in 2021 | | |
| CNY40 000 and below | 741 | 25.87 |
| CNY40 000–CNY80 000 | 641 | 22.38 |
| CNY80 000–CNY120 000 | 644 | 22.49 |
| CNY120 000 and above | 838 | 29.26 |
| Underlying diseases (self-reported)* | | |
| Yes | 640 | 22.35 |
| No | 2224 | 77.65 |

*Underlying diseases include high blood pressure, diabetes, cardiovascular disease and cerebrovascular disease.

#### Knowledge and attitude towards herpes zoster and herpes zoster vaccine

Of the 2864 respondents surveyed, 69.48% had heard of herpes zoster, but only 25.87% had heard of the herpes zoster vaccine. However, the mean (±SD) knowledge score was 7.09 (±4.26), with 58.01% (n=1144) having poor knowledge. The mean (±SD) attitude score was 56.58 (±6.08), with 49.20% of the respondents having negative attitudes towards herpes zoster and the herpes zoster vaccine.

#### Willingness to vaccinate against herpes zoster and its associated factors

Of the 2864 respondents, only 29 (1.01%) had received the herpes zoster vaccine, with a vaccination rate of 1.70% among those aged ≥50 years. A total of 1222 respondents (42.67%) said they would be willing to receive the herpes zoster vaccine in the future, 1028 (35.89%) expressed hesitation, but 614 (21.44%) still said they would not be willing to receive the vaccine in the future.

Respondents were asked to identify the main reasons influencing their willingness to be vaccinated in the future. As shown in figure 2, the most common reason that discouraged respondents from future vaccination was a perceived insufficient need for herpes zoster vaccination due to the low prevalence of herpes zoster. The three most common reasons that motivated respondents to be vaccinated in the future were perceived essential

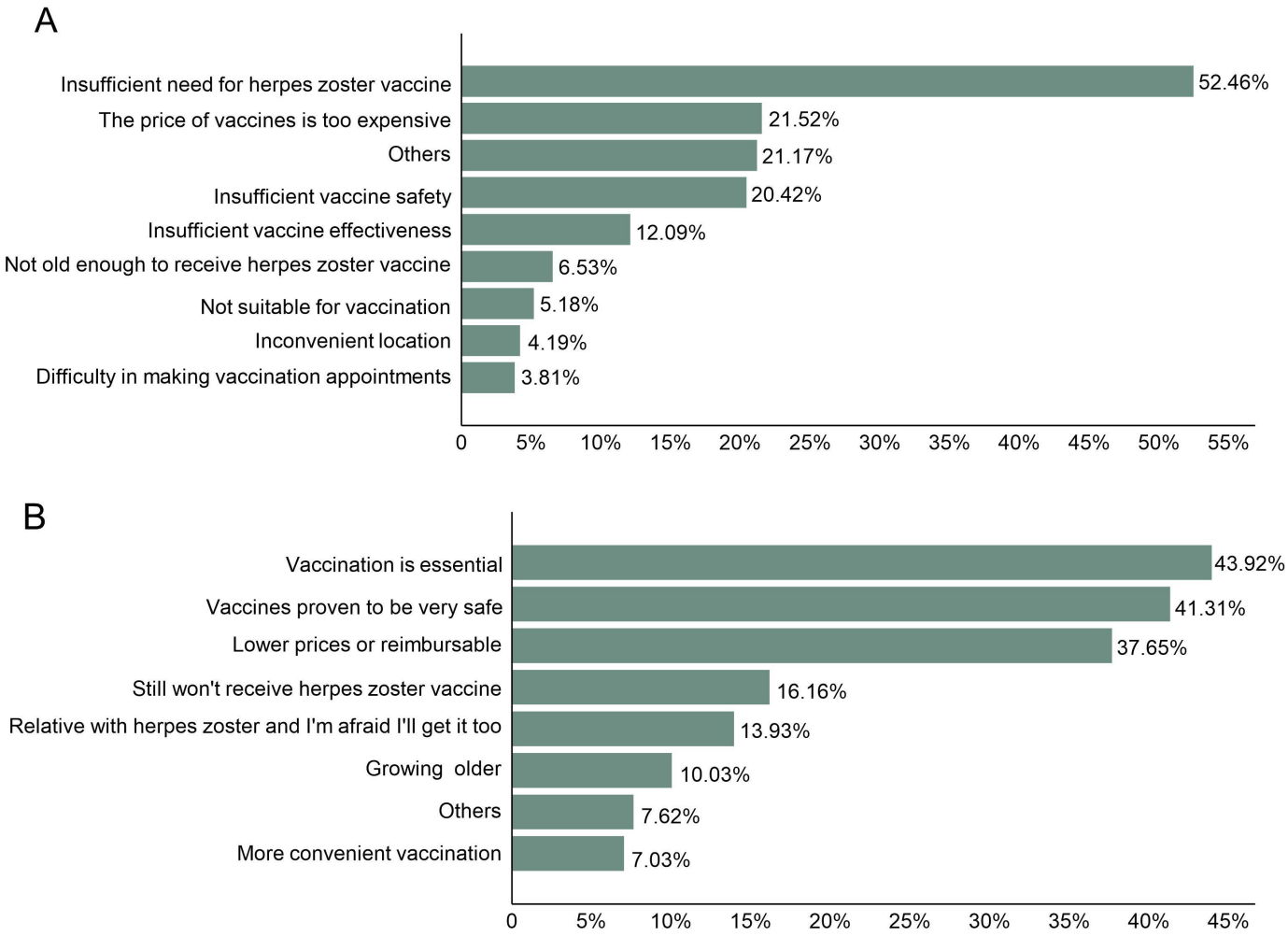


**Figure 2** Multiple response factors influencing willingness to receive herpes zoster vaccine among Chinese residents. Regardless of whether respondents expressed willingness or hesitancy, we examined the reasons for respondents' willingness and unwillingness to receive the vaccine. (A) For willing and unwilling vaccinators, factors influencing their unwillingness to vaccinate. (B) For willing and unwilling vaccinators, reasons motivating them to vaccinate.

vaccination, vaccines proven to be very safe and lower prices or reimbursement for vaccines.

Table 2 shows the results of a multinomial logistic regression comparing the reference group with the 'no' response to examine the determinants of willingness to vaccinate. Males were significantly less likely than females to answer 'not sure' (Adjusted Odds Ratio (aOR) 0.65; 95% CI 0.47 to 0.88) and 'yes' (aOR 0.60; 95% CI 0.45 to 0.81). Older age (40–59 years and ≥60 years) was associated with lower odds of answering 'not sure' and 'yes'. The odds of answering 'yes' were significantly higher among respondents with good knowledge of herpes zoster and the herpes zoster vaccine (aOR 1.82; 95% CI 1.32 to 2.52). Respondents with positive attitudes were significantly more likely to answer 'not sure' (aOR 1.55; 95% CI 1.13 to 2.11) and 'yes' (aOR 3.23; 95% CI 2.39 to 4.38) than those with negative attitudes.

## Qualitative results

Researchers identified four overall and interrelated categories from respondents' responses regarding influential factors affecting herpes zoster vaccination in the population: (1) individual-level factors, (2) vaccine characteristics factors, (3) health service network factors and (4) social and cultural factors. Among the individual-level factors were (1) knowledge of herpes zoster disease, (2) knowledge of herpes zoster vaccine, (3) age, (4) income and (5) pain tolerance. The most commonly reported personal-level factors were knowledge about herpes zoster and the herpes zoster vaccine, age, and income. Respondents who did not receive the vaccine or were reluctant to do so were often unaware of herpes zoster or the herpes zoster vaccine. They also felt that only older people should be vaccinated, and that their household income was so low that they could not afford the cost of the expensive herpes zoster vaccine. Vaccine characteristics factors were (1) vaccine effectiveness, (2) vaccine safety and (3) vaccine price. Similar to the findings of previous studies, the majority of respondents stated that the price of the vaccine was the main vaccine characteristic preventing vaccination, followed by a lack of confidence in the efficacy and safety of the vaccine as a major deterrent. Respondents were concerned about adverse reactions to

Table 2 Factors associated with respondents' willingness to receive HZV

| Variables | Multivariate logistic regression OR (95% CI) | |
|---|---|---|
| | Not sure versus no | Yes versus no |
| Gender | | |
| Female | 1.00 | 1.00 |
| Male | **0.65（0.47–0.88 )** | **0.60（0.45–0.81 )** |
| Age group | | |
| 25–39 | 1.00 | 1.00 |
| 40–59 | **0.49（0.31–0.75 )** | **0.54（0.35–0.83 )** |
| 60 and above | **0.18（0.11–0.29 )** | **0.18（0.11–0.30 )** |
| Education | | |
| Primary and below | 1.00 | 1.00 |
| Middle school | 0.87 ( 0.53–1.41 ) | 0.99 ( 0.61–1.60 ) |
| High school | 0.77 ( 0.47–1.26 ) | 1.38 ( 0.86–2.23 ) |
| College | 0.91 ( 0.51–1.63 ) | 1.40 ( 0.80–2.46 ) |
| Bachelor's degree and above | 1.11 ( 0.63–1.97 ) | 1.13 ( 0.64–1.99 ) |
| Annual net household income in 2021 | | |
| CNY40 000 and below | 1.00 | 1.00 |
| CNY40 000–CNY80 000 | 1.28 ( 0.84–1.95 ) | 1.14 ( 0.75–1.72 ) |
| CNY80 000–CNY120 000 | 1.09 ( 0.71–1.68 ) | 0.90 ( 0.59–1.37 ) |
| CNY120 000 and above | 1.16 ( 0.71–1.89 ) | 1.27 ( 0.79–2.02 ) |
| Underlying diseases (self-reported) | | |
| No | 1.00 | 1.00 |
| Yes | 0.96 ( 0.66–1.40 ) | 0.92 ( 0.64–1.32 ) |
| Knowledge about HZ and HZV | | |
| Poor knowledge | 1.00 | 1.00 |
| Good knowledge | 1.06 ( 0.75–1.49 ) | **1.82（1.32–2.52 )** |
| Attitude | | |
| Negative attitude | 1.00 | 1.00 |
| Positive attitude | **1.55（1.13–2.11 )** | **3.23（2.39–4.38 )** |

Bolded text indicates statistically significant (p <0.05). Underlying diseases include high blood pressure, diabetes, cardiovascular disease and cerebrovascular disease.
HZ, herpes zoster; HZV, herpes zoster vaccine.

vaccination and the perceived short duration of immunity after vaccination. Health service network factors were (1) health literacy accessibility, (2) accessibility of the vaccination service system and (3) quality of vaccination services. A small number of respondents stated poor access to information about the herpes zoster vaccine, inadequate information from healthcare providers or lack of nearby facilities to receive the herpes zoster vaccine as the main reasons for not being vaccinated. The social and cultural factors were (1) social networks, (2) intergenerational relationships and (3) consumption perceptions. The experience of vaccination by friends or family and the experience of illness were the most important social and cultural factors, with respondents indicating that the effectiveness of vaccination by friends or family and the pain of illness would motivate them to be vaccinated. See the qualitative thematic analysis framework in table 3 for details.

### Mixed-method analysis

Both quantitative and qualitative results showed that barriers to receiving the herpes zoster vaccine included lack of knowledge about herpes zoster disease, lack of knowledge about the herpes zoster vaccine, insufficient age, perception of vaccine ineffectiveness and safety, and the high price of the vaccine. The quantitative section also found that men were less willing to be vaccinated than women. The qualitative section also found that barriers to vaccination included income; however, in the quantitative regression model, there was no significant association between income and vaccination willingness. Meanwhile, the qualitative section also showed that the barriers affecting willingness to vaccinate were pain tolerance, accessibility of health knowledge, accessibility of vaccination service system, quality of vaccination service, social network, intergenerational relationship and consumer perception.

## DISCUSSION

Based on a mixed-methods study, we conducted a national survey to investigate the willingness to receive herpes zoster vaccine and its determinants among urban residents in China and analysed potential barriers to vaccination. Results of this study showed that the willingness to receive herpes zoster vaccine among urban residents ≥25 years old in China was 42.67%, including 32.40% among those aged ≥60 years, with similar results to a previous study,[24] but higher than a survey investigating the willingness to receive herpes zoster vaccine among adults aged 50–69 years in Shanghai, China, with differences likely attributable to survey location, sample size, survey date, health education universal access and other factors.[15] The complement of qualitative and quantitative studies showed the following influencing factors: (1) individual characteristic factors; (2) knowledge and attitude factors about herpes zoster and herpes zoster vaccine; (3) vaccine characteristic factors and (4) other factors.

This study described how sociodemographic characteristics influence vaccination willingness. It was found that being female and younger was associated with an increased willingness to vaccinate against the herpes zoster vaccine. This has been confirmed in previous studies. Previous studies in China have shown that being younger, female, having higher income, having a higher education level and being a resident were associated with increased willingness to vaccinate against the herpes zoster vaccine.[15] One study also mentioned a positive association between socioeconomic status (education and income) and vaccination, which may be partly due to differences in knowledge and insurance coverage.[25]

Previous studies have found that knowledge and attitudes towards herpes zoster and herpes zoster vaccine are significantly associated with vaccination willingness,

Table 3 Qualitative thematic analysis framework

| Themes | Factors | Representative quotations |
|---|---|---|
| Individual-level factor | Knowledge of herpes zoster | 'I have never heard of herpes zoster; what is the herpes zoster vaccine used for? I am not considering vaccination.' |
| | Knowledge of herpes zoster vaccine | 'I did not even know there was a herpes zoster vaccine.' 'Aren't all vaccinations the equivalent of injecting a virus into the body, which I think is risky?' |
| | Age | 'Vaccination may be risky for people of advanced age as their immunity decreases with age.' 'I will get vaccinated when I am older.' |
| | Income | 'I cannot afford vaccinations on my low monthly salary.' |
| | Pain tolerance | 'I want this vaccination but I am afraid of the pain.' |
| Vaccine characteristic factors | Vaccine effectiveness | 'I agree that vaccination can prevent herpes zoster, but I get vaccinated on the premise that the vaccine is effective.' |
| | Vaccine safety | 'I am more concerned about the safety of the new vaccine.' |
| | Vaccine prices | 'The current price of this vaccine is too high, and besides, the incidence of herpes zoster is low, so I am not inclined to get the vaccine.' |
| Health service network factors | Health literacy accessibility | 'Advocacy by healthcare providers alone is insufficient, and we rarely get information about herpes zoster disease and prevention.' |
| | Accessibility of the vaccination service system | 'There are currently too few community health centres where you can get herpes zoster vaccine, and too long a wait time for vaccine appointments.' |
| | Quality of vaccination services | 'I feel that the whole arrangement of vaccination service in the community health centre is reasonable, and I am more than satisfied during the vaccination process.' |
| Social and cultural factors | Social networks | 'Many friends have received the herpes zoster vaccine, so I will also get it when I am older.' |
| | Intergenerational relationships | 'I wanted to recommend my parents for vaccination, but they did not feel it was necessary.' |
| | Consumer perception | 'I have a low monthly income, and it goes to my living, so for me to spend CNY3200 for the herpes zoster vaccination is unacceptable.' |

which is consistent with our findings.[15 26] A study in the USA also showed that better knowledge of herpes zoster and herpes zoster vaccine was the main factor influencing respondents' willingness to receive the vaccine.[27] Only 25.87% of respondents in this study stated that they had heard of the herpes zoster vaccine, and more than half of them showed poor knowledge of herpes zoster and herpes zoster vaccine, which indicates a significant knowledge gap among the Chinese population. This finding is similar to the results of previous studies. A systematic review found that more than two-thirds of respondents in 17 countries knew little about the herpes zoster vaccine.[28] A study in Hong Kong, China, also showed that 37.8% had heard of the herpes zoster vaccine, but respondents also lacked knowledge of herpes zoster, with an average herpes zoster knowledge score of 4.96 out of 8. For example, few respondents knew that chickenpox and herpes zoster were caused by the same virus.[22] Also, according to a global survey, knowledge of herpes zoster varied widely across countries, and respondents generally had little knowledge of the causes and symptoms of herpes zoster, with less than 20% of respondents in Turkey, India and Chile knowing about herpes zoster.[29] Furthermore, in our study, nearly half of the respondents had negative attitudes towards herpes zoster and herpes zoster vaccine, and this significantly influenced respondents' willingness to vaccinate, which is consistent with previous studies in China that found that vaccine hesitation influenced willingness to vaccinate.[15] Similarly, a previous Dutch study assessing the determinants of herpes zoster vaccine vaccination in the elderly in the community found that attitudinal factors such as the perceived low risk of herpes zoster infection, short duration of pain and that herpes zoster vaccine vaccination would weaken natural immunity were associated with herpes zoster vaccine vaccination.[30]

Our study also found that the safety, effectiveness and price of herpes zoster vaccine were also critical factors associated with the vaccination willingness. Also, in the USA and other countries, one of the main reasons for non-acceptance of the herpes zoster vaccine in the early

stages of vaccine introduction was respondents' lack of knowledge about herpes zoster and herpes zoster vaccine, the perceived lack of necessity for herpes zoster vaccine, and the high cost of herpes zoster vaccine as established barriers to vaccination.[27 31 32]

In addition, the qualitative component found that findings in this study, therefore, pain tolerance, health literacy accessibility, accessibility of the vaccination delivery system, quality of vaccination services, social networks, intergenerational relationships and consumer perceptions, are also barriers that affect willingness to receive the herpes zoster vaccine. These findings released some information on how to improve herpes zoster vaccination rates, such as gradually increasing population awareness as well as confidence in herpes zoster and herpes zoster vaccine through health education, especially for the most affected elderly, and reducing the cost of vaccination for the population by lowering the price of herpes zoster vaccine.

Based on the above results, this study is a valuable reference for improving herpes zoster vaccination rates, especially for the elderly. It is recommended to intensify publicity and education on the prevention and treatment of herpes zoster to increase public awareness of the risk of herpes zoster and its complications, especially among the elderly; to strengthen the scientific basis for the safety and efficacy of the vaccine to increase public confidence and willingness to receive it, especially among the elderly; to reduce the price of the vaccine and also improve the relevant health insurance policies to reduce the financial burden of herpes zoster vaccination; and to encourage doctors to recommend the vaccine to high-risk groups and to increase their social support.

Our study is the first national study to assess willingness to vaccinate against herpes zoster and barriers to vaccination among urban residents in China. We used a mixed-methods design, analysing the determinants of vaccination willingness in a quantitative section and combining qualitative interviews in a qualitative section to analyse barriers to vaccination willingness. However, the present study has several limitations. First, there may be selection bias in this study. Respondents were recruited from community health centres, which may be more health-conscious and, therefore, more able to access information and vaccines, which may overestimate the results of vaccination willingness and not represent the general population. Second, some of the information collected in this study would also be subject to recall bias. In addition, our study used a face-to-face questionnaire, and there may be a Hawthorne effect, with respondents more likely to choose positive answers.

## CONCLUSION

Our study found a low willingness to be vaccinated against herpes zoster among urban Chinese, especially among the elderly. Factors associated with low vaccination willingness included male gender, younger age, low knowledge of herpes zoster and herpes zoster vaccine, and negative attitudes. In addition, quantitative and qualitative studies showed that low income, high vaccine prices, pain tolerance, health literacy, accessibility of the vaccination system, quality of vaccination services, social networks, intergenerational relationships and consumer attitudes were also barriers to willingness to be vaccinated against herpes zoster. Based on these findings, it is crucial to improve knowledge about herpes zoster and the herpes zoster vaccine through health education and health promotion, and to reduce these barriers to improve herpes zoster vaccination coverage.

**Acknowledgements** We would like to thank all those who participated in this project.

**Contributors** MW conceived and designed the study, conducted data analysis and drafted the manuscript; DZ, MH, YW and YX helped design the analytic strategy and critically reviewed the article; PH and BY helped with study concept and design, data analysis and critical revision of the article. PH is responsible for the overall content as the guarantor. All authors reviewed and approved the final manuscript.

**Funding** This work was supported by the Major Project of the National Social Science Fund of China (21&ZD187) and the National Natural Science Foundation of China (71904005).

**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** Consent obtained directly from patient(s).

**Ethics approval** This study involves human participants and ethical approval for this study was obtained from the Peking University Institutional Review Board (PU IRB) (IRB00001052-20062). 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 upon reasonable request.



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