Factors influencing parents’ willingness to vaccinate their preschool children against COVID-19: Results from the mixed-method study in China

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ABSTRACT
During the COVID-19 pandemic, little is known about parental hesitancy to receive the COVID-19 vaccine for preschool children who are the potential vaccinated population in the future. The purpose of this mixed-method study was to explore the factors influencing Chinese parents’ decision to vaccinate their children aged 3–6 years old against COVID-19. In July 2021, we conducted semi-structured interviews (n = 19) and a cross-sectional survey (n = 2605) with parents of kindergarten children in an urban-rural combination pilot area in China. According to the qualitative study, most parents were hesitant to vaccinate their children with the COVID-19 vaccine. In the quantitative study, we found that three-fifths of 2605 participants were unwilling to vaccinate their children against COVID-19. Furthermore, the main predictors of parents’ intention to vaccinate their children were fathers, lower level of education, and positive attitudes toward vaccination. Based on our findings, targeted health education techniques may be able to boost childhood COVID-19 immunization rates.

1. Introduction
Vaccination is an effective measure in controlling the COVID-19 pandemic. COVID-19 vaccination for children aged 3–11 against COVID-19 has been gradually introduced in China since October 2021. Vaccine hesitancy, the delay in receiving or refusal of vaccination despite the availability of vaccination services, has been considered as a major public health concern worldwide. Parents’ vaccine hesitancy to vaccinate their children has been a concern prior to the COVID-19 pandemic. For instance, the 2019 US National Immunization Survey (NIS) showed that about 20% of parents delay or refuse to vaccinate their kids. Another study conducted in China showed that nearly half of parents delayed their children’s vaccination, and a different percentage of parents were hesitant about vaccine safety, vaccine efficacy and vaccine information. Moreover, due to the imperfect immune system of preschool children and the novelty of the vaccine, parents may hold more negative attitudes toward COVID-19 vaccination in preschool children.

To date, evidence of COVID-19 vaccine hesitancy has accumulated substantially in vaccinated populations such as adults and adolescents. However, parents’ hesitancy to vaccinate their preschoolers against COVID-19 (a potential future vaccination population) remains to be studied, especially in non-urban areas. To our knowledge, two quantitative studies in China have examined parents’ willingness to vaccinate their preschool children against COVID-19 in urban areas, definitely showing that less than 60% of parents had positive attitudes toward COVID-19 vaccination. In addition, parents’ attitudes toward vaccines may turn to be further integrated by demographic characteristics, and socioeconomic factors and psychological factors. Previous studies have shown that economic conditions, parents’ education level, parents’ gender, and fear of adverse effects of vaccines were negatively associated with the degree of hesitancy.

Different models and dimensions have been used in the literature to explain and assess hesitancy toward COVID-19 vaccine. According to the health belief model (HBM), people’s decision to vaccinate against COVID-19 depends on the severity and susceptibility of people to COVID-19 and their perceived effectiveness of vaccination. In addition, there are newly developed scales, such as the Multidimensional Covid-19 Vaccine Hesitancy Scale (CoVaH), which assesses hesitancy against COVID-19 by skepticism, risk perception, and fear of Covid-19 vaccines. The WHO SAGE working group has developed the “3Cs” model, which emphasizes that vaccine hesitancy is related to three issues: complacency (perceived risks of vaccine-preventable diseases), confidence (trust in the safety and efficacy of vaccine and in the health system), and convenience (affordability, geographical accessibility, health literacy and so on).

In this study, we conducted this qualitative and quantitative study to explore the status and factors influencing parents’ hesitation to vaccinate preschool children aged 3–6 years against COVID-19 on the eve of vaccine introduction in an urban-rural combination pilot area in China.
2. Methods

2.1. Study area

The study was conducted in Pidu district, a suburban district of Chengdu. Chengdu is the economic and cultural center in Sichuan Province or even Southwest China as a whole, and is a major destination place for rural migrants in the Southwest region of China. Hongguang Town, located in Pidu district, is a migrant community that crosses geographical, social, administrative, and ideological borders, rather than a town as defined by the administration. With the high proportion of migrants, Hongguang Town serves as an excellent example of urban-rural combination area in China.

2.2. Qualitative methods

2.2.1. Study design and sampling

The qualitative methods of this research allowed us to gain deeper insights into childhood vaccination against COVID-19 decision-making and patient-provider interactions about vaccination in general practice settings. The qualitative methods additionally further our understanding about public health gaps in COVID-19 vaccination implementation programs by paying attention to how participants discuss the Chinese health system in relation to COVID-19 vaccination. Finally, the qualitative methods inform the design of the questionnaire of the quantitative study.

We applied a purposive sampling approach to ensure that our sample reflected a wide range of socio-demographic characteristics, and a semi-structured interview outline was used to interview parents with at least one child aged between 3 and 6 years. A purposive sample of participants was recruited from the Hongguang Health Center in Southwest China through provider referrals. Participants were eligible if they were parents with at least one child aged 3–6 years and were able to converse in Chinese. Given eligibility criteria we did not anticipate significant differences between participants. Due to this consideration and published reports on qualitative sample size considerations, we determined a priori that 12 interviews would likely be sufficient to reach saturation, saturation was first assessed at this point and then after each subsequent interview. Saturation was reached when two investigators agreed that five subsequent interviews did not reveal any new themes. This approach supported the pilot nature of this study and our qualitative descriptive study design.

2.2.2. Data collection

The research team drafted an interview guide to be used as qualitative study tools. The interview guide was written based on relevant vaccine hesitancy literature, in particular the WHO “Three C’s” model (Confidence, Complacency, and Convenience) that has been used to predict the adoption of a specific preventive behavior (vaccinations). The interview guide was developed to guide researchers through semi-structured interviews of open-ended questions with participants, to encourage participants to talk and give their views and opinions, rather than to convince parents to immunize their children (see appendix 1).

The topic guide captured basic socio-demographic information and covered three main subject areas: (1) Participants’ understanding and experience of the childhood COVID-19 vaccination policy, (2) Willingness of children to be vaccinated against COVID-19 and its influencing factors, (3) Expectations of childhood COVID-19 vaccination policy.

Individuals who provided consent participated in face-to-face and 30-minute audio-recorded interviews. Two researchers conducted interviews that were recorded verbatim with the use of an audio recorder. These researchers were all students trained in qualitative research without direct connection with participants. The interviews were conducted in the clinic or in the doctor’s office. Participants remained anonymous when we presented our findings.

2.2.3. Data analysis

All interviews were transcribed verbatim, which were then entered into NVivo for qualitative content analysis. The coding was done at the beginning of the study by using a deductive method but with the advancement of the research and identification of the contents. Meanwhile, an inductive approach was applied for the review. We coded interviews using descriptive manual content analysis, modifying a code list as interviews progressed. Two investigators coded all transcripts in a rolling and iterative manner, adjusting coding to address discrepancies as data was collected. Constant comparative analysis was performed to ensure the credibility and reliability of the data. Despite the fact that the generated codes and themes became repetitious after twelve interviews, recruiting and interviewing continued until the themes were saturated.

2.3. Quantitative methods (cross-sectional survey)

2.3.1. Study design and sampling

According to the preliminary investigation at the qualitative phase, we found that the main reason why parents with at least one child aged between 3 and 6 years in the Pidu district hesitate about childhood vaccination against COVID-19 is concern about the safety & efficacy of the COVID-19 vaccine for children. The quantitative phase of our study sought to explore and quantify the current status and influencing factors of parental intents to vaccinate their children aged 3–6 years old against COVID-19. To this end, we developed questionnaires targeted at the different populations included in our study.

A convenience sampling technique was used to utilize the sample of this study, in which an electronic survey was set on the WIX platform. A link was sent to parents of children in all kindergartens in the Pidu District via their WeChat accounts (n = 2738). The inclusion criteria included any parents with at least one child aged between 3 and 6 years in the Pidu district.

2.3.2. Data collection

The research team constructed a self-administered questionnaire based on The Parent Attitudes about Childhood Vaccines (PACV) Survey. The Parent Attitudes about Childhood Vaccines (PACV) survey is a parent-report measure shown to be a valid and reliable tool for identifying parents who are hesitant toward the primary series of childhood vaccines. Briefly, the PACV contains 15-items under 3 content domains
(behavior, safety & efficacy and trust). It takes 5 minutes or less to complete and reads at a 6th grade level. Responses to individual items on the PACV may also identify the specific vaccine concerns of hesitant parents. To ensure comprehensibility and feasibility, 10 parents who were not included in the final sample were invited to read and answer the translated questionnaires. After the pretest, few modifications were made to assure that the questions were comprehensible and interpreted as intended.

The research team approved a final version of the questionnaire following pilot testing. The instrument consisted of three major sections: 1) socio-demographic characteristics of the respondents and the child (gender, age, occupation, educational level, socioeconomic status, relationship to children of the respondent, gender, and ages of the children in the household); 2) vaccine hesitancy was measured based on PACV that had been translated into Chinese and had been modified in order to investigate the COVID-19 vaccine hesitancy. Table 2 displays the questionnaire item numbers and corresponding questions. The questionnaire had 13 items to identify vaccine hesitancy in three content domains: immunization behavior, COVID-19 safety & efficacy and immunization trust. Furthermore, the questionnaire was composed of three various response formats: dichotomous, 5-point Likert scale (e.g., strongly agree, agree, not sure, disagree, strongly disagree), and eleven-point scale (e.g., responses ranging from “0: not sure at all” to “10: completely sure”). 3) A question “Overall, would you consider having your child get a dose of COVID-19 vaccine?” was used to assess the main study variable, which was the parents’ willingness of their children COVID-19 vaccination.

The form was available from July 13th, 2021 to July 19th, 2021 for 6 days long, before the introduction of encouraging vaccination for children aged 3 to 11 in China that happened on October 24th, 2021.

### 2.3.3. Data analysis

We collapsed responses for survey items into 3 categories: hesitant responses, ‘not sure or don’t know’, and non-hesitant responses. For the 6 items with a 5-point Likert-scale ranging from ‘strongly agree to strongly disagree’, hesitant responses corresponded to the collapsed responses of ‘strongly agree/agree’ for 4 items (Q4–7) and ‘strongly disagree/disagree’ for 2 items (Q12–13), and therefore reflected those who were more strongly hesitant toward vaccines. The reasons that 3 PACV items were categorized differently simply reflected the valence of the question stem. For the 3 items (Q8–10) with a 5-point Likert scale ranging from ‘not at all concerned to very concerned’, hesitant responses corresponded to the collapsed responses of ‘somewhat or very concerned’, while the non-hesitant responses corresponded to ‘not at all or not too concerned’. For yes/no items (Q1–2), ‘yes’ was considered to be the hesitant response and ‘no’ the non-hesitant response. Responses of ‘don’t know’ for 2 survey items (‘Have you ever delayed having your child get a shot for reasons other than illness or allergy?’ and ‘Have you ever decided not to have your child get a shot for reasons other than illness or allergy?’) were excluded as missing data because a ‘don’t know’ response likely reflected poor recall rather than hesitant behavior. However, we included the ‘don’t know/not sure’ data in all other items that assessed immunization attitudes and beliefs because we felt that this response might reflect some hesitancy. We generated an unweighted hesitancy score by assigning hesitant responses to non-demographic survey items a 2, don’t know or not sure a 1, and non-hesitant responses a 0. Each subdomain was divided into hesitation and non-hesitation based on half of their total score. Unweighted item scores were summed to calculate a raw score, and simple linear transformation was used to convert the raw score to a 0–100 point scale. We dichotomized PACV scores into two categories (<50 and ≥50) to be consistent with previous work. The dichotomized subdomain scores and PACV scores were used as the primary predictor variable in our analysis.

For item 14 with a 5-point Likert scale ranging from ‘yes, definitely’ to ‘no, definitely not’, the yes response corresponded to the collapsed responses of ‘yes, definitely or yes’, while the no response corresponded to ‘no, probably not or no, definitely not’ (0 = yes, 1 = don’t know, 2 = no). The parents’ willingness of their children COVID-19 vaccination was used as an ordinal categorical outcome variable in the regression model.

Descriptive statistics were expressed as mean, standard deviation, frequency and percentage. The participants’ socio-demographic characteristics, attitudes, and behaviors toward vaccination, and any reasons for vaccine hesitancy were evaluated with descriptive statistics. Ordinal-logic regression was applied to obtain adjusted odds ratios (OR) for potential confounders that were associated with parents’ willingness of their children COVID-19 vaccination to examine whether these factors had a statistically significant impact on the predictive variables. Table 4 set up two models to determine whether the basic characteristics of the parents, general vaccine hesitancy category (the adaptation of the PACV score <50/low = 0; the adaptation of the PACV score ≥50/high = 1) (model 2, Nagelkerke R² = .068) or its three subdomains (no = 0; yes = 1) (model 1, Nagelkerke R² = .141) were associated with receipt of COVID-19 vaccine. The following independent variables were included in all Models: caregiver age (<35 years old = 0; ≥ 35 years old = 1), caregiver gender (male = 0; female = 1), caregiver career (health sector = 0; other occupation = 1), child age (3–4 years old = 0; 5–6 years old = 1), household (<100K = 0; ≥ 100K = 1), caregiver education (high school or less = 0; baccalaureate/graduate degree = 1). All analyses were conducted using R Project for Statistical Computing version 4.0.2 (Vienna, Austria). The level of statistical significance was set at a p-value of <.05.

### 3. Qualitative results

In total, we interviewed 19 parents, and seven of them were medical professionals. Twelve parents expected to delay vaccinating their children and one parent refused to vaccinate their children. Table 1 shows the socio-demographic characteristics of the participants.

#### 3.1. Most parents were hesitant to vaccinate their children against COVID-19

When interviewers asked interviewees if they would like their children to be vaccinated against COVID-19, only one parent refused:
Children are young and have poor resistance, so we worry about the side effects. (quote 8)

But many (57.9%; n = 11) parents said they needed to consider whether to vaccinate their children in the first place:

We just want to wait for other kids to get vaccinated and if there are no serious side effects, we’ll get vaccinated. (quote 2)

### 3.2. “Three C’s” of vaccine hesitancy

All “Three C’s” (convenience, confidence and complacency) were discussed in the interview. Concerns primarily centered on the vaccine confidence, especially on the safety & efficacy of COVID-19 vaccine.

#### 3.2.1. Convenience

All people were satisfied with immunization services:

The community service is ok, and it’s getting better and better now. (quote 5)

A few of them also mentioned that the queuing time was too long and hoped that it could be improved:

It is very difficult to make an appointment for the first injection, and there will be a long queue and a long wait. (quote 15)

For health care workers, they have better health literacy and understanding than other residents.

I hope the vaccine will boost my child’s immunity against COVID-19. By the way, I suspect that COVID-19, like other major pandemics in history, will not be particularly severe. Due to the emergence of COVID-19 vaccine, people’s immunity has been strengthened, and now the number of deaths is gradually reduced. I think if immunity can be generated, there is no need to worry about this matter. (quote 16)

#### 3.2.2. Complacency

Views relating to complacency involved varying knowledge about vaccines, motivation to vaccinate and so on. Interviewees generally agreed that vaccines were important for their children’s health. But when probed about the specific protective effects of COVID-19 vaccine, many parents (57.9%; n = 11) said they didn’t know:

Of course, I think vaccine is good, but I can’t feel it at present, and I haven’t been to know its efficacy. Sometimes I look it up on the Internet, but it is very superficial. (quote 7)

In addition, the overwhelming majority of parents (84.2%; n = 16) believed that the consequences of SARS-CoV-2 infection in children were serious, but the probability of infection in children was not high if local epidemic prevention was good and there was no source of infection:

I think the epidemic prevention work is very good, so children are not easily infected. (quote 2)

### 3.2.3. Confidence

Whether the interviewees were medical workers or not, they both cared more about whether the vaccine was safe and effective:

I don’t need any other reward, and I think the best thing is that the vaccine is safe and effective. (quote 6)

Most interviewees (89.5%; n = 17) had been vaccinated with COVID-19 vaccine, and some (26.3%; n = 5) people had mild reactions such as muscle soreness after vaccination, so they were worried about adverse reactions among children after vaccination:

My first shot was okay, but my arm hurt after the second shot and I couldn’t lift it up. Of course, I am worried that children will have similar reactions. My child often catches colds, and it seems that he cannot be vaccinated under the circumstances. (quote 9)

There are also parents who are concerned about the long-term safety of the vaccine. They worry that the development process is so fast that there is not enough time for testing to confirm the safety of the new vaccine:

This is a new vaccine. I hope the government can strengthen the protection in this respect if there are adverse reactions in the future so that parents can also feel at ease. (quote 14)

When it comes to trust in policy makers and the health care system, parents show a positive attitude:

I believe in Chinese vaccines. The experts have done so many experiments. I think anything our country makes an effort to make will be better. (quote 16)

### 3.3. Expectations for the vaccination policy

#### 3.3.1. Pay attention to the safety & efficacy of vaccines

When asked by the interviewers whether the interviewees expected children to get any benefits or rewards when children got vaccinated against COVID-19, the interviewees did not care about extra rewards, but cared more about whether the vaccine was safe, effective and protective:

I hope that the vaccine will increase the success rate of anti-infection. Secondly, it’s safe and reliable for children or adults. (quote 5)

I haven’t thought of any other reward, just safe and effective is ok. (quote 6)
3.3.2. Uniform vaccination, free or low-cost vaccination is preferred

More than half of the parents (52.6%; n = 10) hoped that children’s COVID-19 vaccination should be centralized and unified in kindergartens or nurseries. The reason was that parents believed that individual appointment time was uncontrollable and it was difficult to manage children. Children could be vaccinated at school so that teachers could organize and manage children in a more orderly way:

If you get vaccinated at school, you can lighten the burden on adults, because kids will need someone to take care of them. (quote 13)

Table 2. Results of the questionnaire.

| Item | Parents response | N (%) |
|------|------------------|-------|
| 1. Have you ever delayed having your child get a shot (not including seasonal flu shots) for reasons other than illness or allergy? | Yes | 390 (50.0) |
| | No | 2118 (31.3) |
| | Don’t know | 79 (10.5) |
| 2. Have you ever decided not to have your child get a shot (not including seasonal flu shots) for reasons other than illness or allergy? | Yes | 164 (21.8) |
| | No | 387 (21.8) |
| | Don’t know | 463 (28.9) |
| 3. How sure are you that following your child’s doctor suggestions or the recommended shot schedule is a good idea for your child? | Completely sure | 1159 (45.8) |
| | Don’t know | 33 (1.3) |
| | Not at all sure | 226 (8.7) |
| 4. Children get more shots than are good for them. | Agree | 373 (14.3) |
| | Don’t know | 1618 (62.1) |
| | Disagree | 1096 (42.1) |
| 5. I believe that many of the illnesses that shots prevent are severe. | Agree | 1192 (45.8) |
| | Don’t know | 1040 (39.9) |
| | Disagree | 387 (14.9) |
| 6. It is better for my child to develop immunity by getting sick than to get a shot. | Agree | 1159 (44.5) |
| | Don’t know | 33 (1.3) |
| | Disagree | 277 (10.6) |
| 7. It is better for children to get fewer vaccines at the same time. | Concerned | 2215 (85.0) |
| | Not sure | 113 (4.3) |
| | Don’t concerned | 583 (22.4) |
| 8. How concerned are you that your child might have a serious side effect from COVID-19 vaccine? | Concerned | 2215 (85.0) |
| | Not sure | 113 (4.3) |
| | Don’t concerned | 583 (22.4) |
| 9. How concerned are you that COVID-19 vaccine might not be safe? | Concerned | 1962 (73.9) |
| | Not sure | 216 (8.3) |
| | Don’t concerned | 463 (17.8) |
| 10. How concerned are you that COVID-19 vaccine might not prevent the disease? | Concerned | 1596 (61.3) |
| | Not sure | 410 (15.7) |
| | Don’t concerned | 599 (23.0) |
| 11. I trust the information I receive about COVID-19 vaccine. | Agree | 1742 (66.9) |
| | Don’t know | 698 (26.8) |
| | Disagree | 165 (6.3) |
| 12. I am able to openly discuss my concerns about COVID-19 vaccine with my child’s doctor. | Agree | 1936 (74.3) |
| | Don’t know | 542 (20.8) |
| | Disagree | 127 (4.9) |
| 13. All things considered, how much do you trust your child’s doctor? | Yes | 686 (26.3) |
| | 0-10 | 736 (28.0) |
| | Don’t know | 309 (11.9) |
| 14. Overall, would you consider having your child get a dose of COVID-19 vaccine? | No | 1610 (61.9) |

There were also a few people (10.5%; n = 2) worried that their children could not be rescued in the first time when there was an emergency after vaccination:

For example, in the process of inoculation, when the baby needs to be rescued, the parents who are not at the scene even don’t know what happened. So it should be under the supervision of our adults, at least we can see the whole process. (quote 15)

In terms of the price of children’s COVID-19 vaccine, most interviewees (73.7%; n = 14) hoped that children’s COVID-19 vaccine could be vaccinated free of charge, just like adult
COVID-19 vaccine. If children need to be charged for vaccination, the interviewee indicated that a lower price (less than 200 RMB) would be more acceptable:  

The cheaper the better, within two hundred yuan is acceptable. (quote 15)

3.3.3. Optimize the process of vaccine reservation and queuing  
During the interview, most interviewees (84.2%; n = 16) expressed their consideration of the staff and thought that the service level of the vaccination department was high and vaccination was convenient, but there were still problems such as difficulty in vaccine appointments, long queuing time, and deviation between the appointment time and actual vaccination time. They hoped to optimize the process of vaccine appointment queue and vaccination:

There are too many people in the queue, even if the reservation is limited to the number of people. (quote2)

4. Quantitative results  
4.1. Demographic characteristics  
Out of 2738 caregivers contacted during this study, a total of 2605 consented and were enrolled in the survey giving a response rate of 95.1%. Most respondents were female (79.7%) and less than 35 years old (71.4%). In addition, most of them graduated high school and below (48.8%) and had annual income <100K (58.3%).

4.2. Hesitation of immunization and COVID-19 vaccine  
Table 2 displays the results of the questionnaire, including vaccine hesitancy (Q1-Q13) and vaccination willingness (Q14). And vaccine hesitancy is divided into kindergarten children parents’ immunization behavior hesitation (Q1-Q3), COVID-19 vaccine safety & efficacy (Q4-Q10), immunization trust hesitation (Q11-Q13). To evaluate the internal consistency of the instrument applied, the Cronbach’s alpha equation was used, obtaining the alpha value (α) = 0.618 for this population. This value attests that the consistency of answers obtained with this questionnaire is considered substantial and acceptable.23  
Overall, more than half were concerned that COVID-19 vaccine might not prevent the disease (61.3%) and 73.9% and 85.0%, respectively, were concerned about childhood vaccines might not be safe and that serious side effects following immunization. Other results showed that 45.8% of subjects agreed that children get too many jabs, while 62.1% believed many of the illnesses that shots prevent are severe. Almost one-fifth of participants thought it is better for my child to develop immunity by getting sick than to get a shot (18.6%) and 22.4% thought that children ought to get fewer vaccines at the same time. Then, the vast majority agreed that they could discuss their concern with the pediatrician, mean while, their trust in their children’s doctor was very high, reaching an average value of 7.36 on a scale of 0 to 10. At the same time, about three-fifths were hesitant about having their children get a dose of COVID-19 vaccine.

Table 3 gives details of demographic characteristics about general vaccine hesitancy about COVID-19 vaccine and three subdomains. The chart shows that more than one in five respondents were at a low level of hesitation about COVID-19 vaccine and the number of people who had COVID-19 vaccine safety & efficacy hesitation were the largest in three subdomains. Those who were uncertain about COVID-19 vaccine safety & efficacy were mostly younger than 35 years old, female, with a high school degree or below and a household income of less than 100K. In the meanwhile, we can see from the graph that the number of people without immunization behavior hesitation and immunization trust hesitation were the largest proportion. And mothers predominantly had doubts about immunization behavior and trust.

4.3. Willingness of COVID-19 vaccination  
Table 4 constructs to investigate the factors associated with parents’ willingness of their children COVID-19 vaccination.

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Table 3. Demographic characteristics about general vaccine hesitancy about COVID-19 vaccine and three subdomains.

| Survey Items       | Frequency, n (%) | Safety&Efficacy Hesitation | Immunization Behavior Hesitation | Immunization Trust Hesitation | General Vaccine Hesitancy Category |
|--------------------|------------------|----------------------------|----------------------------------|-------------------------------|-------------------------------------|
| Child Age          |                  | Yes | No  | Yes | No  | Yes | No  | Low | High |
| 3–4 years old      | 1306(50.1)       | 869(50.2) | 437(49.9) | 59(44.7) | 1247(50.4) | 118(47.8) | 1188(50.4) | 1002(50.1) | 304(50.2) |
| 5–6 years old      | 1299(49.8)       | 861(49.8) | 438(50.1) | 73(55.3) | 1226(44.7) | 129(52.2) | 1170(49.6) | 997(49.9) | 302(49.8) |
| Caregiver Age      |                  |     |     |     |     |     |     |     |     |
| <35 years old      | 1861(71.4)       | 1273(73.6) | 588(67.2) | 90(68.2) | 1771(71.6) | 179(72.5) | 168(72.1) | 1415(70.8) | 446(73.6) |
| ≥35 years old      | 744(28.6)        | 457(26.4) | 287(32.8) | 42(31.8) | 702(28.4) | 68(27.5) | 676(28.7) | 584(29.2) | 160(26.4) |
| Caregiver Gender   |                  |     |     |     |     |     |     |     |     |
| Male               | 529(20.3)        | 307(17.7) | 222(25.4) | 27(20.5) | 502(20.3) | 37(15.0) | 492(20.9) | 443(22.2) | 86(14.2) |
| Female             | 2076(79.7)       | 1423(82.3) | 653(74.8) | 105(75.5) | 1971(79.7) | 210(85.0) | 1866(79.1) | 1556(77.8) | 520(85.8) |
| Caregiver Education|                  |     |     |     |     |     |     |     |     |
| High school or less| 1909(73.3)       | 1300(75.1) | 609(69.6) | 99(75.0) | 1810(73.2) | 178(72.1) | 1731(73.4) | 1415(72.6) | 458(75.6) |
| Baccalaureate/Graduate degree | 696(26.7) | 430(24.9) | 266(30.4) | 33(25.0) | 663(26.8) | 69(27.9) | 627(26.6) | 548(27.4) | 148(24.4) |
| Caregiver Career   |                  |     |     |     |     |     |     |     |     |
| Health sector      | 72(2.8)          | 44(2.5) | 28(3.2) | 4(3.0) | 68(2.7) | 9(3.6) | 63(2.7) | 57(2.9) | 15(2.5) |
| Other              | 2533(97.2)       | 1686(97.5) | 847(96.8) | 128(97.0) | 2405(97.3) | 238(96.4) | 2295(97.3) | 1942(97.1) | 591(97.5) |
| Household income   |                  |     |     |     |     |     |     |     |     |
| <100 K             | 1518(58.3)       | 1038(60.0) | 480(54.9) | 84(63.6) | 1434(58.0) | 152(61.5) | 1366(57.9) | 1135(56.8) | 383(63.2) |
| ≥100 K             | 1087(41.7)       | 692(40.0) | 395(45.1) | 48(36.4) | 1039(42.0) | 95(38.5) | 992(42.1) | 864(43.2) | 223(36.8) |
The first model illustrated that five variables were statistically linked to that outcome. Fathers (OR = .654, 95% CI .530 - .808, p < .001), and those who have a lower level of education (OR = .820, 95% CI .672 - .998, p = .047) were found to be less likely to be hesitant. In addition, caregivers without immunization behavior hesitation (OR = .730, 95% CI .604 -.882, p < .001) were more willing to have their children get a dose of COVID-19 vaccine. And it is clear from the chart that people without COVID-19 vaccine safety & efficacy hesitation were merely a fifth more likely to make their children get vaccinated. Furthermore, people with positive attitudes toward immunization (OR = .462, 95% CI .307 - .745, p = .001) were more likely to have a willingness to the COVID-19 vaccine uptake for their children.

The second model provided some information that the variable "Male" and "General Vaccine Hesitancy Category (Low)" were the significant determinant of parents’ willingness. Fathers (OR = .732, 95% CI .603 - .890, p = .002) tend to have their children vaccinated against COVID-19. Moreover, parents with low general vaccine hesitancy (OR = .304, 95% CI .244 - .379, p < .001) are more likely to make their children get vaccinated. The rest of the models were not significant.

5. Discussion

Our study found that fathers were more willing than mothers to vaccinate their children in this survey, which is consistent with the gender difference seen among Goldman's research on caregiver willingness to vaccinate their children against COVID-19. This probably because fathers have different risk taking behaviors than those of mothers, which is similar to findings related to child play and pediatric trauma prevention. It highlights that public health interventions targeted to families should provide gender-specific parental education campaigns to maximize vaccination acceptability.

Our data showed that high levels of education are predictive of intention to vaccinate their children against COVID-19. E. Hak also reported a lower rate of intent to comply with new vaccines in the vaccination program among highly educated persons. Since the average educational level has increased over the last decades, it is reasonable to assume that an increasing number of people will adopt a skeptical attitude toward vaccinations, not only in western countries but also in China. If that is the case, then more convincing evidence of vaccine efficacy may be needed to change the attitudes of some highly educated parents to a positive intent toward the vaccine use in China.

It was determined that parents of children who experienced an adverse event might have particular difficulty in making the decision on vaccinating their children against COVID-19. Therefore, public health staff should focus on providing specialized vaccine services for children who experienced previous adverse reactions to improve increasing vaccination rates. Noteworthy, a previous Italian study showed that the hesitant families were more prone to over-estimating the severity of the reported adverse events and the reverse association could not be ruled out. Understandably, there is a relationship between parents’ hesitant attitudes toward other childhood vaccines and their COVID-19 vaccination attitudes. In our study, COVID-19 vaccine hesitancy was found to be significantly higher in parents who had negative attitudes toward vaccines in general. Waller J et al. found that good cognition could lead to better behavior and improved the attitude toward vaccination.

In our study, the results of both qualitative and quantitative studies suggest that concerns regarding safety & efficacy are strongly associated with vaccine hesitation. Concerns about adverse effects were reported as the most common reason (68–86%) for parents to refuse to vaccinate their children, while the development of COVID-19 vaccines in a very short time implies that it is impossible to know its long-term efficacy and possible side effects, discouraging people from vaccinating their children. This observation may be explained by the fact that parents consider older vaccines safer and more effective than newer vaccines, and they hope for more experience with a future vaccine before caregivers expose their children to the new product. Gust et al. in the USA concluded that information or reassurance from healthcare providers were the main factor in changing the decision of parents. Therefore, healthcare providers and those responsible for positive consultation addressing parents’ ideas and concerns and providing accurate information to parents, are encouraged to minimize parents’ uncertainty and build confidence in the safety & efficacy of vaccines.
The results of qualitative studies released some information on how to improve vaccination rates. Some parents complained about the troubles of booking and queuing for vaccines and look forward to solving this problem. A simple and efficient vaccination system may help increase their willingness. In the meanwhile, the cost reduction would be beneficial to vaccinate more children against the COVID-19.

There are several limitations to our various surveys. First, the participants from the study were selected in an urban-rural combination pilot area in Chengdu, therefore generalizability of our findings to other areas may be limited. Second, the sample size in qualitative research was limited, which would not allow conclusive evidence to be drawn about additional factors between parental concerns and their children’s COVID-19 vaccine uptake. Third, few health care workers were involved in the quantitative component, therefore, the association between parental occupation and willingness to COVID-19 vaccination might not be significant. Fourth, quantitative research required the use of smartphones, which may result in missing out on groups that are not adept at smart products. Moreover, the study was a cross-sectional study, and causal relationships between parental willingness and some demographic characteristics, general vaccine hesitancy and its three subdomains: immunization behavior hesititation, safety & efficacy hesititation and immunization trust hesititation could not be established.

6. Conclusion

In conclusion, we observed kindergarten parents’ willingness to vaccinate their children against COVID-19 and several important determinants, including male, low academic qualification, non-immunization-behavior hesititation, non-immunization-trust hesititation, non-safety & efficacy hesititation and general vaccine hesitancy about COVID-19 vaccine. Among these factors, the safety & efficacy of COVID-19 vaccine were shown to be strongly associated with caregivers’ willingness to receive vaccination in both qualitative and quantitative studies. Personalized health education initiatives based on these characteristics may be beneficial in reducing caregivers’ concerns about the COVID-19 vaccination in preschool children.

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