SSM - Population Health 24 (2023) 101517

Contents lists available at ScienceDirect

SSM - Population Health

journal homepage: www.elsevier.com/locate/ssmph

# Impact of household decision makers' hesitancy to vaccinate children against COVID-19 on other household members: A family-based study in Taizhou, China

Jing-Shan Deng [a], Chen-Qian Ying [a], Xiao-Qing Lin [a], Chun-Lian Huang [a], Mei-Xian Zhang [b], Tao-Hsin Tung [b,**], Jian-Sheng Zhu [a,*]

[a] Department of Infectious Diseases, Taizhou Hospital of Zhejiang Province Affiliated to Wenzhou Medical University, Linhai, Zhejiang, 317000, China
[b] Evidence-based Medicine Center, Taizhou Hospital of Zhejiang Province Affiliated to Wenzhou Medical University, Linhai, Zhejiang, 317000, China

ARTICLE INFO

*Keywords:*
COVID-19 vaccine
Vaccine hesitancy
Children
Family Decision Makers

ABSTRACT

*Background:* Vaccination is the most effective means of preventing outbreaks of infectious diseases, and family ; decision makers play an important role in decision-making regarding family matters and may influence other family members to take an active role in vaccinating children against COVID-19.
*Purpose:* This study examined the influence of family decision makers on the hesitation of other family members to vaccinate their children against COVID-19.
*Methods:* A population-based, self-administered online questionnaire was administered in Taizhou, China, from September 1, 2021, to September 15, 2021. The questionnaire included demographic information, knowledge, attitudes, and perceptions about the COVID-19 vaccine as well as hesitation regarding the use of the COVID-19 vaccination in children. In total, 490 respondents were included in this study. Logistic regression was used to assess the factors associated with vaccine hesitancy.
*Results:* In total, 490 respondents from 190 households were interviewed. Of the 190 family decision makers, 43.7% (83/190) were hesitant to vaccinate their children against COVID-19. When family decision makers were hesitant to vaccinate children against COVID-19, 65.1% (82/126) of the other family members expressed similar hesitancy regarding vaccination. When family decision makers were not hesitant to vaccinate children, only 21.3% (37/174) of other family members were hesitant to do so. In the regression analysis, family decision makers' hesitation to vaccinate their children was associated with other family members' hesitation (OR=6.264, 95% CI:3.132–12.526). In addition, decision makers' perceptions of the safety of the vaccine (OR=0.422, 95% CI:0.215–0.826) and hesitation to vaccinate themselves (OR=8.967, 95% CI:4.745–16.948) influenced their hesitation to vaccinate their children.
*Conclusion:* The present study found that family decision makers' hesitation to vaccinate children against COVID-19 influenced other family members' hesitation to vaccinate children. In addition, family decision makers' perceptions of the safety of the vaccine and their hesitation to vaccinate themselves influenced other family members' hesitation to vaccinate their children.

## 1. Introduction

The coronavirus disease-19 (COVID-19) pandemic has become a global public health problem(An et al., 2021; Bhagat et al., 2022). To prevent the spread of the pandemic, governments are recommending active preventive measures, such as wearing masks, maintaining social distancing, and disinfecting everyday items(Marzo et al., 2022). Vaccines remain the cornerstone of stopping infectious disease outbreaks

* Corresponding author. Department of Infectious Diseases, Taizhou Hospital of Zhejiang Province, Wenzhou Medical University, 150 Ximen Street, Linhai, 317000, Zhejiang Province, China.
** Corresponding author. Evidence-based Medicine Center, Taizhou Hospital of Zhejiang Province, Wenzhou Medical University, 150 Ximen Street, Linhai, 317000, Zhejiang Province, China.
*E-mail addresses:* a1738512693@163.com (J.-S. Deng), yingchenqian2022@163.com (C.-Q. Ying), linxiaoqing4162@163.com (X.-Q. Lin), 17275833360@163.com (C.-L. Huang), meixian0116@163.com (M.-X. Zhang), ch2876@yeah.net (T.-H. Tung), zhujs@enzemed.com (J.-S. Zhu).

https://doi.org/10.1016/j.ssmph.2023.101517
Received 3 June 2023; Received in revised form 13 August 2023; Accepted 18 September 2023
Available online 21 September 2023

and are the most effective means of defense against pandemics and epidemics (Excler et al., 2021; WHO, 2020). The World Health Organization (WHO) estimates that national immunization programs save approximately 3 million lives per year and are among the most cost-effective public health interventions (WHO, 2020). However, vaccine hesitancy affects vaccine rollout. Over the past 30 years, vaccine hesitancy rates have risen globally (Dubé et al., 2021). The WHO Strategic Advisory Group of Immunization Experts (SAGE) defines vaccine hesitancy as the "delayed receipt or refusal of vaccination despite the availability of vaccination services" (MacDonald & SAGE Working Group on Vaccine Hesitancy, 2015a). Disease models developed by Lo and Hotez showed that small changes in vaccination coverage can lead to large increases in morbidity with significant epidemiological consequences (Forbes et al., 2021; Lo & Hotez, 2017).

Vaccination has been shown to protect children from infection and long-term COVID-19 effects (Schleiss et al., 2021). Moreover, another study found that parents are one of the main influences regarding the vaccination of children against COVID-19 (Alimoradi et al., 2023).

The family decision maker makes decisions within the family that affect the choices of the entire family (Luo et al., 2022). Children rely on their parents and other family members to manage complex healthcare decisions owing to their lack of judgment and autonomy (Gutman et al., 2018). In the absence of effective treatment, many countries around the world are trying to control the spread of COVID-19 outbreaks, including the implementation of quarantines and lockdowns, maintaining social distancing, the use of face masks at all times in the community, and restricting travel, and China is no exception (Lin et al., 2020). Since August 2021, in China, adolescents aged 12–17 years have been vaccinated with the COVID-19 inactivated-virus vaccine, followed by children under the age of 12 years (Tung et al., 2022). The Chinese government actively mobilizes people for COVID-19 vaccination by providing free vaccination, and the success of this policy depends on people's willingness to be vaccinated (Liu, Zhang, et al., 2021; Meng et al., 2021). In this context, it is important to explore the role played by household decision makers in deciding whether to vaccinate against COVID-19. Therefore, in the wider context of the COVID-19 pandemic, a family-based study exploring the influence of the family's primary decision maker on the hesitancy of family members to vaccinate children against COVID-19 is beneficial for protecting children's health and providing a basis for future responses to infectious disease epidemics.

## 2. Methods

### 2.1. Study design and data collection

A cross-sectional online survey was conducted in Taizhou, China, between September 1 and 15, 2021. Wen-Juan-Xing was utilized as the survey platform, and the target population was a neighborhood in Taizhou, China, composed of households. The participants completed a self-administered survey by scanning a QR code. We chose a community in Taizhou, China, and collected questionnaires from every household in the community (Luo et al., 2022). A logical check was performed, and outliers were eliminated before data analysis. The time taken to complete the questionnaire was converted logarithmically, and if it exceeded mean ±3SD, it was considered an outlier and was also excluded from the analysis. A total of 824 questionnaires remained following quality control. After the application of high-level controls, 402 houses (402/1002) and 824 respondents were included.

Our inclusion criterion was households that included both family decision makers and other family members. Our exclusion criteria were as follows: (1) households with only family decision makers and (2) families with no family decision maker. In total, 334 questionnaires were excluded, leaving 190 families (490 people) for inclusion in our study. Fig. 1 depicts the workflow for sample selection.

All procedures were performed in accordance with the guidelines of the Institutional Ethics Committee and adhered to the Declaration of Helsinki. Information from the respondents was anonymized.

### 2.2. Structured questionnaires and measurement

The questionnaire that we designed was based on previous studies that assessed vaccine hesitancy (Xu et al., 2023). We conducted pilot interviews to ensure the scientific accuracy and clarity of the questionnaire.

The introduction to the questionnaire described the background and purpose of the survey and stated that it was anonymous and voluntary. The content of the questionnaire was as follows: (1) basic demographic information of the respondents, including gender, education level, and occupation type; (2) personal background information of the respondents such as "Are you the main decision maker in your family? (Yes; No)"; (3) respondents' knowledge, attitudes, and behaviors about COVID-19 such as "How much do you know about COVID-19 vaccines?" (A lot; Nothing), "How safe do you think the current COVID-19 vaccines are?" (Safe; Unsafe), "Do you continue to pay attention to information about the COVID-19 vaccine?" (Yes, No), and "Have you hesitated to get vaccinated against COVID-19?" (Hesitated; No hesitation)"; and (4) respondents' hesitation to vaccinate children against COVID-19, such as "Are you hesitant to vaccinate children under 18 years old?" (Hesitant; Not hesitant).

We combined "Are you the main decision maker in your household?" with the above questions to form the following new variables: (1) the gender of the decision maker, (2) the education level of the decision maker, (3) the decision maker's response to COVID-19 vaccine knowledge, (4) the decision makers' views on the safety of COVID-19 vaccines, (5) whether decision makers continue to pay attention to COVID-19 vaccine information, and (6) whether decision makers are hesitant to vaccinate themselves against COVID-19.

### 2.3. Statistical analysis

The survey determined how family decision makers affected the COVID-19 vaccination efforts of other family members. The study also examined the demographic details and hesitancy of vaccinating children against COVID-19, represented as proportion (n [%]) values. Chi-square tests were performed to determine potential factors in family non-decision makers' hesitancy to vaccinate their children against COVID-

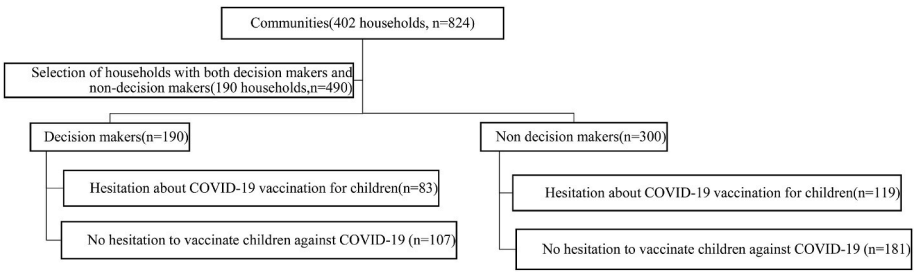


**Fig. 1.** Sample selection flow chart.

19. Factors influencing families' hesitancy to vaccinate their children against COVID-19 were further investigated using logistic regression analysis.

Only variables with a p-value of less than 0.2 in the chi-square or *t*-test, were included in the binary logistic regression model (Jiang et al., 2022). In this study, binary logistic regression analysis was used to examine the influence of family decision makers on other family members' hesitancy to vaccinate their children against COVID-19. The odds ratio (OR) and 95% confidence interval (CI) were estimated using IBM SPSS statistical software, with statistical significance set at $P < 0.05$. We chose for Hosmer-Lemeshow test and Cox and Snell's $R^2$ to indicate the goodness of the model fit.

## 3. Results

In this study, 402 households and 824 individuals completed the questionnaire; 190 households and 490 respondents were included according to the flowchart of the sample selected for this study. As shown in Table 1, of the 490 respondents, 50.0% (245/490) were male, 22.7% (111/490) were students, 13.3% (211/490) were workers, and 56.9% (279/490) had a junior high school education or below.

Of the 190 family decision makers, 43.7% (83/190) were hesitant to vaccinate children against COVID-19. When family decision makers were hesitant to vaccinate children, 65.1% (82/126) of other family members had similar hesitancy regarding vaccination. When family decision makers were not hesitant to vaccinate children, only 21.3% (37/174) of other family members were hesitant to do so (Fig. 2).

The results of the univariate analysis are presented in Table 2. The family decision maker's hesitation to vaccinate children against COVID-19 was associated with other family members' hesitation to vaccinate children against COVID-19 ($\chi2 = 58.622$, $P < 0.001$). In addition, whether the decision maker had a chronic disease ($\chi2 = 4.679$, $P = 0.031$), the decision maker's perception of the safety of the vaccine ($\chi2 = 6.895$, $P = 0.009$), and whether the decision maker was hesitant to be vaccinated themselves ($\chi2 = 23.341$, $P < 0.001$) were associated with other family members' hesitation to vaccinate their children.

We further analyzed the extent to which these factors were associated with non-decision makers' hesitation to vaccinate children against COVID-19 using a binary logistic regression model. As shown in Table 3, household decision makers' hesitation to vaccinate children against COVID-19 was associated with family members' hesitation to vaccinate children (OR=6.264, 95% CI:3.132–12.526). In addition, decision makers' perceptions of COVID-19 vaccine safety (OR=0.422, 95% CI:0.215–0.826) and hesitation to vaccinate themselves (OR=8.967, 95% CI:4.74516.948) were associated with non-decision makers' hesitation to vaccinate their children.

## 4. Discussion

This study explored the role of family decision makers in childhood COVID-19 vaccination. We found that family decision makers' hesitation to vaccinate children against COVID-19 influenced other family members' hesitation to vaccinate children, and when family decision makers were hesitant to vaccinate children, 65.1% of family members were hesitant to vaccinate children against COVID-19.

In the decision-making process, families encounter numerous dilemmas and challenges (Lopez & Guarino, 2011). Regarding important matters, family members participate in decision making together; however, the decision maker's decision plays an important role in making decisions for the entire family (Cohen et al., 2010; Trees et al., 2017; Vig et al., 2006). When making decisions for patients, family decision makers typically organize other family members to make decisions about the patient's treatment, and they respond to the decision maker's opinions (Rolland et al., 2017). This explains why family decision makers' hesitancy to vaccinate children influences other family members' hesitation regarding this issue. Therefore, public health departments need to understand the role of family decision makers in addressing childhood vaccine hesitancy and focus on the important role played by key family decision makers so that childhood vaccination efforts can achieve better results.

The present study found that other family members were more hesitant to vaccinate their children against COVID-19 when the family decision maker believed that the vaccine was unsafe and was hesitant to be vaccinated themselves. According to the social normativity theory, for members living in the same household, the attitude of the household decision maker toward something will become a reference for other family members (de Klepper et al., 2009; Deutsch & Gerard, 1955), and

**Table 1**
Basic characteristics of respondents in the study (n = 490).

| Independent Variables | Categories | Total Sample, n (%) | COVID-19 vaccination hesitation | |
|---|---|---|---|---|
| | | | Hesitation | No hesitation |
| | | 490(100) | 202(41.2) | 288 (58.8 ) |
| Decision maker | Yes | 190(38.8) | 83(43.7 ) | 107 (56.3 ) |
| | No | 300(61.2) | 119 (39.7 ) | 181 (60.3 ) |
| Sex | Male | 245 (50.0 ) | 105 (42.9 ) | 140 (57.1 ) |
| | Female | 245 (50.0 ) | 97(39.6 ) | 148 (60.4 ) |
| Age | <=18 | 84(17.1 ) | 37(44.0 ) | 47(56.0 ) |
| | 19–45 | 200 (40.8 ) | 78(39.0 ) | 122 (61.0 ) |
| | 46–60 | 151 (30.8 ) | 64(42.4 ) | 87(57.6 ) |
| | >60 | 55(11.2 ) | 23(41.8) | 32(58.2) |
| Education level | Junior high school and below | 279 (56.9 ) | 118 ( 58.4 ) | 161 (57.7 ) |
| | High school and above | 211 (43.1 ) | 84(39.8 ) | 127 (60.2 ) |
| Occupation | Student | 111 (22.7 ) | 52(46.8 ) | 59(53.2 ) |
| | Worker | 65(13.3 ) | 30(46.2 ) | 35(53.8 ) |
| | Farmer | 52(10.6 ) | 33(63.5 ) | 19(36.5 ) |
| | Teacher | 4(0.8 ) | 1(25.0 ) | 3(75.0 ) |
| | Medical Staff | 1(0.2 ) | 0(0 ) | 1(100.0 ) |
| | Government department staff | 10(2.0 ) | 3(30.0 ) | 7(70.0 ) |
| | Other | 247 (50.4 ) | 83(33.6 ) | 164 (66.4 ) |
| Allergy history | Yes | 8(1.6 ) | 5(62.5 ) | 3(37.5 ) |
| | No | 482 (98.4 ) | 197 (40.9 ) | 285 (59.1 ) |
| Underlying disease | Yes | 36(7.3 ) | 24(66.7 ) | 12(33.3 ) |
| | No | 454 (92.7 ) | 178 (39.2 ) | 276 (60.8 ) |
| Flu vaccination | Yes | 24(4.9 ) | 14(58.3 ) | 10(41.7 ) |
| | No | 466 (95.1 ) | 188 (40.3 ) | 278 (59.7 ) |
| Knowledge on the COVID-19 vaccines | A lot | 313 (63.9 ) | 95(30.4 ) | 218 (69.6 ) |
| | Nothing | 177 (36.1 ) | 107 (60.5 ) | 70(39.5 ) |
| Confidence in safety of the COVID-19 vaccines | Safe | 317 (64.7 ) | 85(26.8 ) | 232 (73.2 ) |
| | Unsafe | 173 (35.3 ) | 117 (67.6 ) | 56(32.4 ) |
| Continued attention to COVID-19 vaccine information | Yes | 294 (60.0 ) | 100 (34.0 ) | 194 (66.0 ) |
| | No | 196 (40.0 ) | 102 (52.0 ) | 94(48.0 ) |
| Hesitation about getting the COVID-19 vaccine for yourself | Yes | 158 (32.2 ) | 122 (77.2 ) | 36(22.8 ) |
| | No | 332 (67.8 ) | 80(24.1 ) | 252 (75.9 ) |

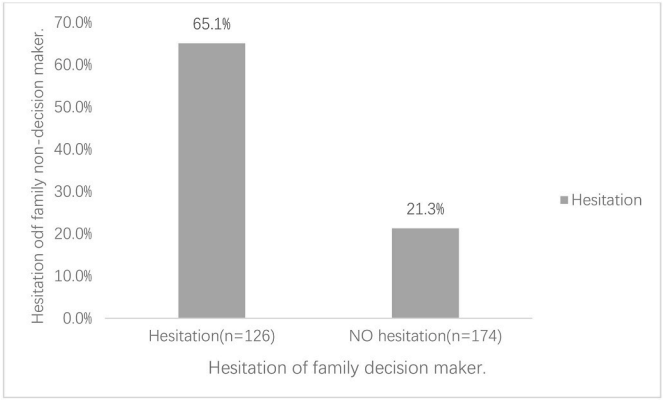


**Fig. 2.** Hesitation of non-decision makers when decision makers are hesitant to vaccinate children against COVID-19 in 190 households(n=300).

the opinions of powerful family decision makers are more persuasive within the family (Dubois et al., 2016; Kirby et al., 1998; Lammers et al., 2013). Family decision-making is a group decision and a process of mutual integration between decision makers and family members (Fu, 2014). When a family decides whether to vaccinate a child against COVID-19, the family decision maker has more power in the family. When making decisions with other family members, each person's ideas and attitudes converge. This may explain why family decision makers believe that the COVID-19 vaccine is unsafe and are hesitant to be vaccinated themselves; other family members' perceptions of the safety of the vaccine and their hesitancy to be vaccinated themselves may also be influenced by the decision maker. Because of cultural differences across regions, each location has a different perspective on risk when dealing with a COVID-19 outbreak (Kreuter & McClure, 2004). China and the United States have different perspectives on the risk of COVID-19 outbreaks, which may lead to different vaccination policies. The United States uses many incentives (e.g., cash lotteries) to motivate people to get vaccinated (Sargent et al., 2022; Sload et al., 2022). The Chinese government strongly encourages the population to receive the COVID-19 vaccine; therefore, family decision makers have the power to decide whether to immunize their children with the COVID-19 vaccine (COVID-19 Vaccination Free to Chinese). However, the cultures of the two countries are rather different and, therefore, cannot be directly compared. Further research is required to demonstrate the impact of culture on policy. In addition, our study also found that when family decision makers were hesitant to vaccinate themselves, other family members were hesitant to vaccinate their children. This is similar to the results found in the United States, Israel, Taiwan, and China, all of which suggest that parents' attitudes toward their own vaccination affect their attitudes toward child vaccination. Studies in the aforementioned countries have confirmed that parents' willingness to vaccinate themselves affects their willingness to vaccinate their own children (Deng et al., 2023; Galanis et al., 2022; Gendler & Ofri, 2021; Ruiz & Bell, 2022).

Concerns about the safety and efficacy of vaccines are important predictors of parents vaccinating their children. Moreover, when parents are concerned about the safety of vaccines, they are more hesitant to vaccinate their children (Kempe et al., 2020; Nyhan & Reifler, 2015). This may explain why family decision makers' perceptions of vaccine safety and their hesitation to vaccinate themselves influence other family members' hesitation to vaccinate their children. The Rational Theory of Behavior and Theory of Planned Behavior propose that attitudes are the main predictors of behavior (Ajzen & Fishbein, 1980, 1985). Family decision makers may be more hesitant to vaccinate children against COVID-19 when they are hesitant to be vaccinated themselves. Therefore, when addressing vaccine hesitancy, public health departments should understand the reasons for the population's hesitancy to vaccinate children and start by changing the attitudes of family decision makers to enhance their understanding of the safety as well as the risks and benefits of the vaccine and increase their willingness to vaccinate children against COVID-19.

Factors such as sex, age, education, and income affect people's hesitation to receive the COVID-19 vaccination (Hudson & Montelpare, 2021; Troiano & Nardi, 2021). For example, people with low levels of education lack knowledge of the effectiveness and safety of vaccines or have persistent anti-vaccine attitudes, which affect their attitudes toward vaccination (Larson et al., 2016). However, the current study did not find a relationship between respondents' basic characteristics and

**Table 2**
Univariate analysis of household non-decision makers' hesitation to vaccinate children against COVID-19 versus decision makers (n = 300).

| Independent Variables | Categories | COVID-19 vaccination hesitation | | | |
|---|---|---|---|---|---|
| | | Hesitation, n(%) | No hesitation, n(%) | χ2/t | P |
| | | 119(39.7) | 181(60.3) | | |
| Decision makers hesitate to vaccinate children against COVID-19 | Yes | 82(65.1) | 44(34.9) | 58.622 | <0.001 |
| | No | 37(21.3) | 137(78.7) | | |
| Gender of decision makers | Male | 88(38.1) | 143(61.9) | 1.036 | 0.309 |
| | Female | 31(44.9) | 38(55.1) | | |
| Education level of decision makers | Junior high school and below | 78(37.3) | 131(62.7) | 1.585 | 0.208 |
| | High school and above | 41(45.1) | 50(54.9) | | |
| Allergy history of decision makers | Yes | 1(50.0) | 1(50.0) | 0.090 | 0.764 |
| | No | 118(39.6) | 180(60.4) | | |
| Underlying disease of decision makers | Yes | 14(60.9) | 9(39.1) | 4.679 | 0.031 |
| | No | 105(37.9) | 172(62.1) | | |
| Flu vaccination of decision makers | Yes | 3(42.9) | 4(57.1) | 0.030 | 0.861 |
| | No | 116(39.6) | 177(60.4) | | |
| Level of knowledge of COVID-19 vaccine among decision makers | A lot | 69(36.1) | 122(63.9) | 2.754 | 0.097 |
| | Nothing | 50(45.9) | 59(54.1) | | |
| Level of safety of COVID-19 vaccine among decision makers | Safe | 68(34.3) | 130(65.7) | 6.895 | 0.009 |
| | Unsafe | 51(50.0) | 51(50.0) | | |
| Continued attention to COVID-19 vaccine information by decision makers | Yes | 68(35.8) | 122(64.2) | 3.255 | 0.071 |
| | No | 51(46.4) | 59(53.6) | | |
| Decision makers hesitant to vaccinate themselves against COVID-19 | Yes | 82(65.1) | 44(34.9) | 23.341 | <0.001 |
| | No | 37(21.3) | 137(78.7) | | |

**Table 3**
Binary logistic regression analysis of household non-decision makers' hesitation to vaccinate children against COVID-19 decision makers (n = 300).

| Independent Variables | Categories | B | OR | P |
|---|---|---|---|---|
| Decision makers hesitate to vaccinate children against COVID-19 | Yes vs. No | 1.835 | 6.264 (3.132–12.526) | <0.001 |
| Underlying disease of decision makers | Yes vs. No | 0.603 | 1.238 (0.396–3.873) | 0.714 |
| Level of knowledge of COVID-19 vaccine among decision makers | A lot vs. Nothing | 0.603 | 1.828 (0.929–3.599) | 0.081 |
| Level of safety of COVID-19 vaccine among decision makers | Safe vs. Unsafe | −0.863 | 0.422 (0.215–0.826) | 0.012 |
| Continued attention to COVID-19 vaccine information by decision makers | Yes vs. No | −0.338 | 0.713 (0.377–1.351) | 0.300 |
| Decision makers hesitant to vaccinate themselves against COVID-19 | Yes vs. No | 2.194 | 8.967 (4.745–16.948) | <0.001 |

p-value for Hosmer-Lemeshow test=0.795.
Cox and Snell $R^2$=0.188.

vaccine hesitancy. This study should be expanded on in future research to better clarify the role of basic characteristics in vaccine hesitancy.

Vaccine hesitancy is a complex issue caused by many factors including environmental, individual, group, and specific issues related to vaccination (MacDonald & SAGE Working Group on Vaccine Hesitancy, 2015b). Several factors influence a person's decision to be vaccinated themselves and to vaccinate their children (Butler et al., 2015; Larson et al., 2018). Therefore, targeted measures are required to address vaccination hesitancy. Families are among the factors that influence an individual's health status, and focusing on families and individuals to promote health is more synergistic than targeting individuals (Ferrer et al., 2005; McLeroy et al., 1988). Therefore, the government and various sectors need to explore the role that families play in society, place the issue of childhood vaccine hesitancy in the family context, and understand the interactions among family members regarding vaccination.

In the face of the complex issue of vaccine hesitancy, this study on family decision makers provides information regarding other vaccinations for children in China. China regards immunization as a basic right, and since 1962, the Ministry of Health has required all provinces to vaccinate children against smallpox, BCG, diphtheria, whooping cough, and polio every year free of charge(Yu et al., 2018). In China's immunization program, vaccines are divided into national expanded program for immunization (EPI) and non-EPI vaccines. EPI vaccines such as BCG, poliomyelitis, measles, and diphtheria are free and mandatory for children(Ji et al., 2022). Non-EPI vaccines are self-funded vaccines and include, for example, the rabies, influenza, hepatitis B, and HPV vaccine; they are not required to be mandatory (Han et al., 2022). As of 2019, the vaccination rate of school-aged children in China is approximately 99% (Ye et al., 2022). However, vaccination rates for non-EPI vaccines remain low in China compared with the near-universal coverage of EPI vaccines, for example, HPV vaccine coverage is only 3.1%(Deng et al., 2021; Liu, Xu, et al., 2021; Zhang et al., 2018). In consideration of this situation, understanding the attitudes of decision makers regarding childhood vaccination is extremely important for improving vaccination rates.

This family-based study examined the influence of family decision makers on other family members in regard to vaccinating their children against COVID-19. However, this study has several limitations, and further research is required. First, this was a cross-sectional study and could not assess long-term vaccine hesitancy. Moreover, it studied a specific time period; therefore, cohort studies should be conducted in the future. Second, the sample size was limited; the study was conducted in one community, and representativeness may be somewhat affected. Therefore, effort should be made to expand the sample size and enhance the representativeness of the findings in future studies. Third, the present discussion only explored the links between household decision makers and other family members and did not distinguish among the types of decision makers or decision-making styles, nor did it include further analysis of the characteristics of decision makers. Fourth, we did not exclude students younger than 18 years from the sample, which, to some extent, could potentially bias and prevent valid comparisons with adults who are decision makers and are not under the influence of their parents. Fifth, our Cox and Snell $R^2$ is only 0.188, which is not a good fit, and we need to make adjustments in this area in the future. Finally, the use of an online approach to collect questionnaires may lead to vaccine hesitancy being separated from the real situation, that is, over- or under-hesitancy to vaccinate children with COVID-19. Future research should be conducted using multiple approaches to improve the accuracy of these findings.

## 5. Conclusion

The current study found that family decision makers' hesitation to vaccinate children against COVID-19 influenced other family members' hesitation to vaccinate children. Additionally, family decision makers' perceptions of the safety of the vaccine and their hesitation to vaccinate themselves influenced other family members' hesitation to vaccinate their children. Family-based and enhanced outreach to family decision makers regarding the new COVID-19 vaccine will help address vaccine hesitancy, increase COVID-19 vaccine coverage, and reduce the risk of children contracting the new COVID-19 virus.

## Ethics approval and consent to participate

This study was approved by the Ethics Committee of Taizhou Hospital, Zhejiang Province (approval number: K20210705). All strategies were conducted in accordance with the guidelines of the Institutional Ethics Committee and adhered to the Declaration of Helsinki, and all participant data were anonymized. Ethics Committee of Taizhou Hospital , Zhejiang Province waived informed consent from participants.

## Consent for publication

This section is not applicable.

## Availability of data and materials (ADM)

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Funding

This study was no any funding.

## Author statement

J.S. Z. and T.H.T. conceived the study. M.X.Z., J.S. Z. and T.H.T. designed the questionnaire. J.S.Z. collected the data. J.S.D. was responsible for analyzing and writing the first draft of the paper. C.Q. Y., C.L.H. and X.Q L. searched, sorted and interpreted the relevant literature. All authors edited and approved the final manuscript.

We thank the participants for their cooperation and support.

## Declaration of competing interest

The authors have no proprietary interest in any aspect of this study. There was no additional financial support from public or private

sources. There's no financial/personal interest or belief.

## Data availability

Data will be made available on request.

## Acknowledgments

We thank the participants for their cooperation and support.

## References


Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In J. Kuhl, & J. Beckman (Eds.), *Action-control: From cognition to behavior* (pp. 11–39). Heidelberg, Germany: Springer-Verlag.

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs, NJ: Prentice-Hall.

Alimoradi, Z., Lin, C. Y., & Pakpour, A. H. (2023). Worldwide estimation of parental acceptance of COVID-19 vaccine for their children: A systematic review and meta-analysis. *Vaccines, 11*(3), 533.

An, P. L., Nguyen, H. T. N., Dang, H. T. B., Huynh, Q. N. H., Pham, B. D. U., & Huynh, G. (2021). Integrating health behavior theories to predict intention to get a COVID-19 vaccine. *Health Services Insights, 14*, Article 11786329211060130.

Bhagat, S., Yadav, N., Shah, J., et al. (2022). Novel corona virus (COVID-19) pandemic: Current status and possible strategies for detection and treatment of the disease. *Expert Rev Anti Infect Ther, 20*(10), 1275–1298.

Butler, R., MacDonald, N. E., & SAGE Working Group on Vaccine Hesitancy. (2015). Diagnosing the determinants of vaccine hesitancy in specific subgroups: The Guide to Tailoring Immunization Programmes (TIP). *Vaccine, 33*(34), 4176–4179.

Cohen, M. J., McCannon, J. B., Edgman-Levitan, S., & Kormos, W. A. (2010). Exploring attitudes toward advance care directives in two diverse settings. *Journal of Palliative Medicine, 13*(12), 1427–1432.

COVID-19 vaccination free to Chinese residents: Official. Available online: http://www.ecns.cn/news/2021-01-09/detailihafqmaz1834647.shtml.

Deng, J. S., Chen, J. Y., Lin, X. Q., Huang, C. L., Tung, T. H., & Zhu, J. S. (2023). Parental hesitancy against COVID-19 vaccination for children and associated factors in Taiwan. *BMC Public Health, 23*(1), 571.

Deng, C., Chen, X., & Liu, Y. (2021). Human papillomavirus vaccination: Coverage rate, knowledge, acceptance, and associated factors in college students in mainland China. *Human Vaccines & Immunotherapeutics, 17*(3), 828–835.

Deutsch, M., & Gerard, H. B. (1955). A study of normative and informational social influences upon individual judgment. *Journal of Abnormal Psychology, 51*(3), 629–636.

Dubé, È., Ward, J. K., Verger, P., & MacDonald, N. E. (2021). Vaccine hesitancy, acceptance, and anti-vaccination: Trends and future prospects for public health. *Annual Review of Public Health, 42*, 175–191.

Dubois, D., Rucker, D. D., & Galinsky, A. D. (2016). Dynamics of communicator and audience power: The persuasive- ness of competence versus warmth. *Journal of Consumer Research, 43*(1), 68–85.

Excler, J. L., Saville, M., Berkley, S., & Kim, J. H. (2021). Vaccine development for emerging infectious diseases. *Nature Medicine, 27*(4), 591–600.

Ferrer, R. L., Palmer, R., & Burge, S. (2005). The family contribution to health status: A population-level estimate. *The Annals of Family Medicine, 3*(2), 102–108.

Forbes, H., Morton, C. E., Bacon, S., et al. (2021). Association between living with children and outcomes from covid-19: OpenSAFELY cohort study of 12 million adults in england [published correction appears in BMJ. 2021 mar 22;372:n794]. *BMJ, 372*, n628.

Fu, Y. X. (2014). Convergence management of family strategies and individual decision making conflicts[J]. *Management Observation*, (31), 179–182 (in Chinese).

Galanis, P., Vraka, I., Siskou, O., Konstantakopoulou, O., Katsiroumpa, A., & Kaitelidou, D. (2022). Willingness, refusal and influential factors of parents to vaccinate their children against the COVID-19: A systematic review and meta-analysis. *Preventive Medicine, 157*, Article 106994.

Gendler, Y., & Ofri, L. (2021). Investigating the influence of vaccine literacy, vaccine perception and vaccine hesitancy on Israeli parents' acceptance of the COVID-19 vaccine for their children: A cross-sectional study. *Vaccines, 9*(12), 1391.

Gutman, T., Hanson, C. S., Bernays, S., et al. (2018). Child and parental perspectives on communication and decision making in pediatric CKD: A focus group study. *American Journal of Kidney Diseases, 72*(4), 547–559.

Han, K., Hou, Z., Tu, S., et al. (2022). Investigate non-EPI vaccination recommendation practice from a socio-ecological perspective: A mixed-methods study in China. *Vaccines, 10*(12), 2105. Published 2022 Dec 8.

Hudson, A., & Montelpare, W. J. (2021). Predictors of vaccine hesitancy: Implications for COVID-19 public health messaging. *International Journal of Environmental Research and Public Health, 18*(15), 8054. Published 2021.

Jiang, N., Yang, C., Yu, W., Luo, L., Tan, X., & Yang, L. (2022). Changes of COVID-19 knowledge, attitudes, practices and vaccination willingness among residents in Jinan, China. *Frontiers in Public Health, 10*, Article 917364.

Ji, M., Huang, Z., Ren, J., & Wagner, A. L. (2022). Vaccine hesitancy and receipt of mandatory and optional pediatric vaccines in Shanghai, China. *Human Vaccines & Immunotherapeutics, 18*(5), Article 2043025.

Kempe, A., Saville, A. W., Albertin, C., et al. (2020). Parental hesitancy about routine childhood and influenza vaccinations: A national survey. *Pediatrics, 146*(1), Article e20193852.

Kirby, S. D., Ureda, J. R., Rose, R. L., & Hussey, J. (1998). Peripheral cues and involvement level: Influences on acceptance of a mammography message. *Journal of Health Communication, 3*(2), 119–135.

de Klepper, M., Sleebos, E., van de Bunt, G., & Agneessens, F. (2009). Similarity in friendship networks: Selection or influence? The effect of constraining contexts and non-visible individual attributes[J]. *Social Networks, 32*(1).

Kreuter, M. W., & McClure, S. M. (2004). The role of culture in health communication. *Annual Review of Public Health, 25*, 439–455.

Lammers, J., Dubois, D., Rucker, D. D., et al. (2013). Power gets the job: Priming power improves interview outcomes[J]. *Journal of Experimental Social Psychology, 49*(4), 776–779.

Larson, H. J., Clarke, R. M., Jarrett, C., et al. (2018). Measuring trust in vaccination: A systematic review. *Human Vaccines & Immunotherapeutics, 14*(7), 1599–1609.

Larson, H. J., de Figueiredo, A., Xiahong, Z., et al. (2016). The state of vaccine confidence 2016: Global insights through a 67-country survey. *EBioMedicine, 12*, 295–301.

Lin, Y., Hu, Z., Zhao, Q., Alias, H., Danaee, M., & Wong, L. P. (2020). Understanding COVID-19 vaccine demand and hesitancy: A nationwide online survey in China. *PLoS Neglected Tropical Diseases, 14*(12), Article e0008961. Published 2020 Dec 17.

Liu, Y., Xu, Y., Wang, J., et al. (2021). Vaccination pattern of the 23-valent pneumococcal polysaccharide vaccine (PPV23) in Hangzhou, China: A coverage and adverse events following immunization of different age groups. *Human Vaccines & Immunotherapeutics, 17*(1), 157–161.

Liu, R., Zhang, Y., Nicholas, S., Leng, A., Maitland, E., & Wang, J. (2021). COVID-19 vaccination willingness among Chinese adults under the free vaccination policy. *Vaccines, 9*(3), 292. Published 2021 Mar 21.

Lo, N. C., & Hotez, P. J. (2017). Public health and economic consequences of vaccine hesitancy for measles in the United States. *JAMA Pediatrics, 171*(9), 887–892.

Lopez, R. P., & Guarino, A. J. (2011). Uncertainty and decision making for residents with dementia. *Clinical Nursing Research, 20*(3), 228–240.

Luo, C., Zhang, M. X., Jiang, E., Jin, M., Tung, T. H., & Zhu, J. S. (2022). The main decision-making competence for willingness-to-pay towards COVID-19 vaccination: A family-based study in Taizhou, China. *Annals of Medicine, 54*(1), 2376–2384.

MacDonald, N. E., & SAGE Working Group on Vaccine Hesitancy. (2015a). Vaccine hesitancy: Definition, scope and determinants. *Vaccine, 33*(34), 4161–4164.

MacDonald, N. E., & SAGE Working Group on Vaccine Hesitancy. (2015b). Vaccine hesitancy: Definition, scope and determinants. *Vaccine, 33*(34), 4161–4164.

Marzo, R. R., Ahmad, A., Islam, M. S., et al. (2022). Perceived COVID-19 vaccine effectiveness, acceptance, and drivers of vaccination decision-making among the general adult population: A global survey of 20 countries. *PLoS Neglected Tropical Diseases, 16*(1), Article e0010103.

McLeroy, K. R., Bibeau, D., Steckler, A., & Glanz, K. (1988). An ecological perspective on health promotion programs. *Health Education Quarterly, 15*(4), 351–377.

Meng, Z., Shan, S., & Zhang, R. (2021). China's COVID-19 vaccination strategy and its impact on the global pandemic. *Risk Management and Healthcare Policy, 14*, 4649–4655. Published 2021 Nov 15.

Nyhan, B., & Reifler, J. (2015). Does correcting myths about the flu vaccine work? An experimental evaluation of the effects of corrective information. *Vaccine, 33*(3), 459–464.

Rolland, J. S., Emanuel, L. L., & Torke, A. M. (2017). Applying a family systems lens to proxy decision making in clinical practice and research. *Families, Systems & Health, 35*(1), 7–17.

Ruiz, J. B., & Bell, R. A. (2022). Parental COVID-19 vaccine hesitancy in the United States. *Public Health Reports, 137*(6), 1162–1169.

Sargent, R. H., Laurie, S., Moncada, L., et al. (2022). Masks, money, and mandates: A national survey on efforts to increase COVID-19 vaccination intentions in the United States. *PLoS One, 17*(4), Article e0267154.

Schleiss, M. R., John, C. C., & Permar, S. R. (2021). Children are the key to the endgame: A case for routine pediatric COVID vaccination. *Vaccine, 39*(38), 5333–5336.

Sload, J., Bechtolsheim, B., & Gifford, D. (2022). Assessing the impact of vaccine lotteries on COVID-19 vaccination rates in the United States in 2021. *American Journal of Public Health, 112*(8), 1130–1133.

Trees, A. R., Ohs, J. E., & Murray, M. C. (2017). Family communication about end-of-life decisions and the enactment of the decision-maker role. *Behavioral Sciences, 7*(2), 36. Published 2017 Jun 7.

Troiano, G., & Nardi, A. (2021). Vaccine hesitancy in the era of COVID-19. *Public Health, 194*, 245–251.

Tung, T. H., Lin, X. Q., Chen, Y., Zhang, M. X., & Zhu, J. S. (2022). Willingness to receive a booster dose of inactivated coronavirus disease 2019 vaccine in Taizhou, China. *Expert Rev Vaccines, 21*(2), 261–267.

Vig, E. K., Taylor, J. S., Starks, H., Hopley, E. K., & Fryer-Edwards, K. (2006). Beyond substituted judgment: How surrogates navigate end-of-life decision-making. *Journal of the American Geriatrics Society, 54*(11), 1688–1693.

WHO. (2020). *Low investment in immunization and vaccines threatens Global Health*.

Xu, R., Shi, G., Zheng, S., Tung, T. H., & Zhang, M. (2023). COVID-19 vaccine hesitancy between family decision-makers and non-decision-makers among college teachers. *Annals of Medicine, 55*(1), 292–304.

Ye, J., Cao, L., Yu, W., et al. (2022). Surveillance for routine vaccination coverage with National Immunization Program vaccines among age-eligible children in China, 2016 - 2019. *Chin. J. Vac. Immu., 28*(1), 94–100 (in Chinese).

Yu, W., Lee, L. A., Liu, Y., et al. (2018). Vaccine-preventable disease control in the people's Republic of China: 1949-2016. *Vaccine, 36*(52), 8131–8137.

Zhang, X., Syeda, Z. I., Jing, Z., et al. (2018). Rural-urban disparity in category II vaccination among children under five years of age: Evidence from a survey in shandong, China. *International Journal for Equity in Health, 17*(1), 87. Published 2018 Jun 22.