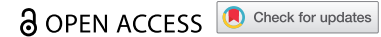


RESEARCH ARTICLE



Parents' willingness to pay for their children's COVID-19 vaccine in Taiwan, China: A cross-sectional study

Chun-Lian Huang^{a*}, Jau-Yuan Chen^{b*}, Xiao-Qing Lin^{id a}, Jing-Shan Deng^a, Tao-Hsin Tung^{id c}, and Jian-Sheng Zhu^{id a}

^aDepartment of Infectious Diseases, Taizhou Hospital of Zhejiang Province Affiliated to Wenzhou Medical University, Linhai, Zhejiang, Taiwan;

^bDepartment of Family Medicine, Chang Gung Memorial Hospital, Taoyuan City, Taiwan, China; ^cEvidence-based Medicine Center, Taizhou Hospital of Zhejiang Province Affiliated to Wenzhou Medical University, Linhai, Zhejiang, China

ABSTRACT

Most COVID-19 studies aim to assess factors influencing willingness to pay for vaccines between the public and medical staff. However, few studies focus on parents' willingness to pay for their children's COVID-19 vaccine. The current study aimed to assess parents' willingness to pay for their children's vaccination against COVID-19 and its influencing factors. This population-based cross-sectional study used a self-administered questionnaire. The inclusion criterion was parents with at least one child younger than 18 years. The final analysis included 384 valid data points. A total of 89.1% of the parents indicated that they are willing to pay for their children's vaccination against COVID-19. Among them, both fathers' and mothers' willingness to pay for their children's COVID-19 vaccine was 89.6%. The mean and median willingness to pay were% would pay for their children. Excluding other confounding factors, willingness to pay for the COVID-19 vaccine for themselves and hesitation to vaccinate their children were significantly associated with parents' willingness to pay for their children's COVID-19 vaccine. We found that 89.1% of the parents in Taiwan would pay for their children's COVID-19 vaccine. Parents' willingness to pay for themselves and hesitation to vaccinate their children were associated with willingness to pay. Reducing hesitation about vaccines and developing policies for vaccine payment may have a positive impact on willingness to pay for vaccines and promoting COVID-19 vaccination.

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Introduction

Willingness to pay (WTP) for a vaccine is an assessment of the maximum amount people are willing to spend on vaccination.^{1,2} Previous studies found that WTP is influenced by many factors, such as an individual's health status, socio-economic characteristics, previous vaccination history, knowledge, attitudes and practices regarding vaccination, and peer or physician recommendations.³ The factors influencing WTP may also vary across different regions or populations.⁴ Therefore, identifying the determinants associated with WTP is crucial for reducing the risk of recurrent widespread outbreaks.⁵

An outbreak of severe acute respiratory syndrome was caused by the coronavirus disease in 2019 (COVID-19). People had no resistance to this emerging virus.⁶ Vaccination helps to achieve herd immunity and is considered as one of the most effective methods of combating the COVID-19 pandemic. Most significantly, it lowers the prevalence of COVID-19 in children.⁷ However, the SARS-CoV-19 virus is subject to constant mutation, and commercially available vaccines provide only limited immunity; therefore, regular vaccinations are required to achieve successful herd immunity.⁸ To enhance the availability of the COVID-19 vaccine, it has been made available for children aged 3–17 years since July 2021.⁹





Parents are key decision-makers in determining children's WTP for COVID-19 vaccination, and measuring parental attitudes plays an important role in achieving full childhood immunization.^{10,11} There are limited studies assessing parents' WTP and its influencing factors on their children's COVID-19 vaccination. A study in the United States showed that men, African Americans, and Africans had a higher WTP for their offspring, and that this WTP increased with income.¹² A cross-sectional study in the Taizhou region of China showed that lower literacy levels, one-child families, knowledge of vaccine use, and parents' WTP for themselves are four aspects that can influence parents' WTP for their children.⁹

Few studies have examined parents' WTP for their children's COVID-19 vaccine. The current study, conducted in Taiwan, China, was designed to assess parents' WTP for their children's COVID-19 vaccine and its influencing factors.

Materials and methods

Study design and population

This population-based cross-sectional study was based on an online survey that was conducted among parents in Taiwan between July 14, 2021, and September 23, 2021. Participants completed a questionnaire survey using the WeChat platform.

CONTACT Jian-Sheng Zhu  zhujs@enzemed.com  Department of Infectious Diseases, Taizhou Hospital of Zhejiang Province, Wenzhou Medical University, 150 Ximen Street, Linhai, Zhejiang 317000, China; Tao-Hsin Tung  ch2876@yeah.net  Evidence-based Medicine Center, Taizhou Hospital of Zhejiang Province, Wenzhou Medical University, 150 Ximen Street, Linhai, Zhejiang 317000, China.

*Contributed equally to the work.

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The inclusion criterion was being a parent with at least one child younger than 18 years. Exclusion criteria: Taiwan residents who are unwilling to participate in the survey, unmarried or whose children's age is higher than 18 years old. The study procedure was approved by the Ethics Committee of Taizhou Hospital, Zhejiang Province, and was performed in accordance with the ethical guidelines of the World Medical Association (Declaration of Helsinki) and the CHERRIES statement. Participants' personal information was fully anonymized.

Questionnaire frame

An online questionnaire comprising multiple sections was developed, based on previous relevant research and a framework for estimating WTP for the COVID-19 vaccine.^{9,13} The formal questionnaire was determined by a panel of two experts in the relevant field to ensure that the content was comprehensive, valid and scientific. The initial questionnaire was first tested, then revised based on feedback from the test population, and finally the formal questionnaire was finalized. The sections are as follows:

- (1) Basic demographic information (gender, age, place of residence, education level, previous vaccination history).
- (2) Parental knowledge related to the COVID-19 vaccine, including the following questions: "How much do you know about the COVID-19 vaccine," "how effective do you think the COVID-19 vaccine is in preventing COVID-19 pneumonia," and "how safe do you feel the current COVID-19 vaccine is?"
- (3) Parental hesitation and WTP for their own COVID-19 vaccination was addressed using these questions: "Have you ever hesitated to get the COVID-19 vaccine, whether you received it or not," "would you get it if you had to pay for the COVID-19 vaccine," and "what price would you accept for the COVID-19 vaccine?"
- (4) With regard to parents' hesitation and WTP for their child's COVID-19 vaccination, we asked the following questions: "Do you hesitate to have your children receive the COVID-19 vaccine," "are you likely to vaccinate your children if there is a fee for the COVID-19 vaccine," and "what is the price you are willing to pay for the COVID-19 vaccine for your child?"

For simplicity, parents' WTP for themselves, parents' WTP for their children, and parents' hesitance about vaccines were re-recorded in the final analysis. "Very willing" and "willing" to be marked "yes;" "Very reluctant" and "reluctant" to be marked "no."

Statistical analysis

This study used chi-squared tests and a binary logistic regression analysis to identify the factors associated with parents' WTP for children in two steps. In the first step, the variables in our study were all enumeration data, so a χ^2 (chi-square) test was applied to compare the discrepancies between the WTP

group and the reluctant to pay (RTP) group, which initially assessed possible factors associated with parents' WTP for their children's vaccines; these include gender, place of residence, education level, knowledge and attitude toward the COVID-19 vaccine, and hesitation to vaccinate their children. Second, in the variables with statistical significance in the chi-square test, binary logistic regression was performed to identify the factors associated with parents' WTP for the vaccine for their children. All inferential tests were performed under the following assumptions: corrected advantage ratios with 95% CI and p -values ($p < .05$). The mean and median of the estimated WTP are shown in dollars. Data were analyzed using IBM SPSS statistics 26.0 software (SPSS Inc, Chicago, IL, USA). A p -value $< .05$ was established to represent statistical significance among the test populations.

Results

Sociodemographic characteristics of the parents

A total of 384 parents completed the online questionnaire. Table 1 presents the sociodemographic characteristics of the parents. Of the 384 parents, 80.2% (308/384) were female, 84.6% (325/384) lived in urban areas, 90.1% (346/384) had a university or higher education, and 43.0% (165/384) were medical workers.

Relationship between parents' WTP for their children and for themselves

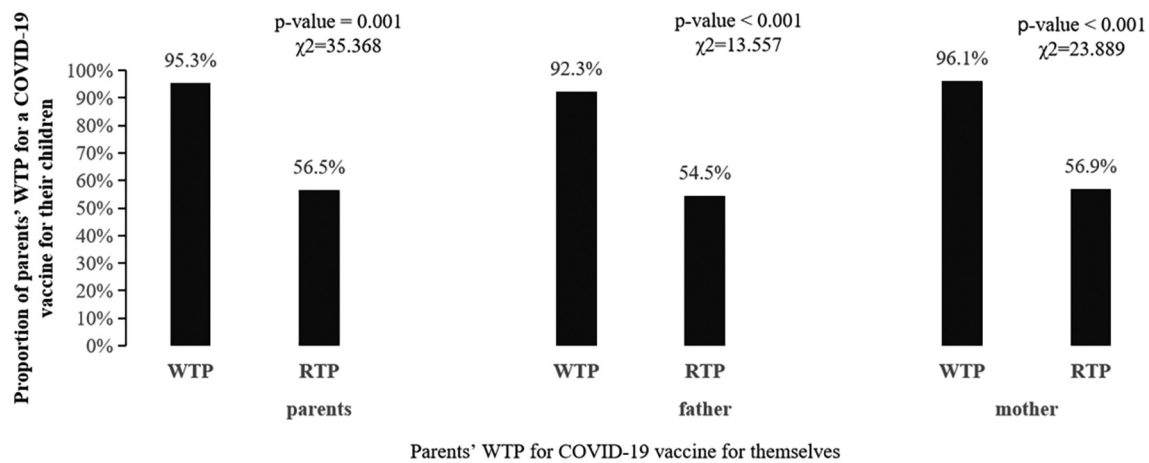
Parents willing to pay for their children's vaccines comprised 89.1% (342/384). Among them, both fathers' and mothers' WTP for their children's COVID-19 vaccines was 89.6%. As shown in Table 1, a total of 72.4% (278/384) of parents were willing to pay less than NT 1,000 (\$33.20) for their children's vaccinations; 83.9% (322/384) of parents would pay for the vaccine for themselves, and 73.4% (282/384) of parents were willing to pay the same amount, NT 1,000 (US\$ 33.20), for themselves. The mean and median amounts parents were willing to pay for themselves or their children were $< NT 1,000$ (US \$ 33.20). From Figure 1, we can see an interesting finding that of the parents who were not willing to pay for the COVID-19 vaccine for themselves, 56.5% (35/62) would pay for their child and of those who would pay for themselves, 95.3% (307/322) were willing to pay for their child. The relationships between parents' WTP for themselves and parents' WTP for their children were significant (p -value $< .001$) both in fathers and mothers.

Factors affecting parents' WTP for the COVID-19 vaccine for their children

As shown in Table 2, the χ^2 (chi-square) test showed an inconsistency between the WTP group and the RTP group. We assessed the potential factors of WTP for several univariate variables: education level ($\chi^2 = 2.425$, $p = .119$), degree of knowledge of the COVID-19 vaccine ($\chi^2 = 4.638$, $p = .031$), preventive effect of the COVID-19 vaccine ($\chi^2 = 6.332$, $p = .012$), safety of the COVID-19

Table 1. Sociodemographic characteristics of the parents (N = 384).

Characteristics	N (%)
Gender	
Male	76 (19.8)
female	308 (80.2)
Education level	
Senior Secondary and below	38 (9.9)
Undergraduate and above	346 (90.1)
Number of children (<18 years)	
One	145 (37.8)
Two	203 (52.9)
Three and above	36 (9.3)
Occupation	
Worker	111 (28.9)
Medical worker	165 (43.0)
Education	37 (9.6)
Civil servant	18 (4.7)
Other	53 (13.8)
Residence	
Urban	325 (84.6)
Towns & Rural	59 (15.4)
Parents' WTP for COVID-19 vaccine for their children	
Yes	342 (89.1)
No	42 (10.9)
Parents' WTP for COVID-19 vaccine for their themselves	
Yes	322 (83.9)
No	62 (16.1)
Price paid by parents for their children's COVID-19 vaccine(NT)	
<1000	278 (72.4)
1000 ~ 1499	72 (18.6)
1500 ~ 1999	19 (5.0)
>2000	15 (4.0)

**Figure 1.** Relationship between parents' WTP for their children and for themselves.

vaccine ($\chi^2 = 7.871$, $p = .005$), parents' hesitation to vaccinate themselves ($\chi^2 = 0.459$, $p = .498$), parents' WTP for their own COVID-19 vaccine ($\chi^2 = 80.720$, $p < .001$), and parents' hesitation to vaccinate their children ($\chi^2 = 9.603$, $p = .002$). Mothers had the same potential factors of WTP for their children's vaccine as parents overall (mothers and fathers). However, the WTP for their COVID-19 vaccination among fathers ($\chi^2 = 11.741$, $p = .001$) differed between the RTP and WTP group. However, there were no statistical differences in parents' WTP in terms of gender, place of residence, education level, and previous vaccination history with the COVID-19 vaccine.

Independent factors affecting parents' WTP for their children's COVID-19 vaccine were further analyzed using a binary

logistic regression model. As shown in Table 3, excluding possible confounding factors and after stratification by gender, parents' WTP for their own COVID-19 vaccination (yes or no, odds ratio [OR] = 13.77, 95% confidence interval [CI]: 6.51–29.11), parents' hesitation to vaccinate their children (yes or no, OR = 3.50, 95% CI: 1.25–9.79), and parents' willingness to vaccinate their children with WTP for the COVID-19 vaccine were significantly associated with the same influencing factors as for mothers. However, fathers' WTP for their children's vaccination was significantly associated only with their WTP for their own vaccination (yes or no, OR = 6.12, 95% CI: 1.21–31.10).

The main reason parents were hesitant to vaccinate their children against COVID-19 was that they were concerned

Table 2. Differences in parents' WTP for their children's COVID-19 vaccination between WTP group and RTP group (N = 384).

Variables	Categories	Parents (n = 384)			Fathers (n = 76)			Mothers (n = 308)		
		WTP (n = 342)	RTP (n = 42)	p-value	WTP (n = 66)	RTP (n = 10)	p-value	WTP (n = 276)	RTP (n = 32)	p-value
Gender	men	66 (19.3)	10 (23.8)	.489	66 (100)	10 (100)	/	/	/	/
	women	276 (80.7)	32 (76.2)		/	/		276 (100)	32 (100)	
Residence	urban	291 (85.1)	34 (81.0)	.483	58 (87.9)	7 (70.0)	.134	233 (84.4)	27 (84.4)	.995
	Towns & Rural	51 (14.9)	8 (19.0)		8 (12.1)	3 (30.0)		43 (15.6)	5 (15.6)	
Education level	Senior Secondary and below	31(9.1)	7(16.7)	.119	4(6.1)	2(20.0)	.128	27(9.8)	5(15.6)	.305
	Undergraduate and above	311(90.9)	35(83.3)		62(93.9)	8(80.0)		249(90.2)	27(84.4)	
Allergic reactions to previous vaccinations	yes	53(15.5)	7(16.7)	.844	6(9.1)	0(0)	.320	47(17.0)	7(21.9)	.495
	no	289(84.5)	35(83.3)		60(90.9)	10(100)		229(83)	25(78.1)	
Preventive effect of COVID-19	yes	340 (99.4)	40 (95.2)	.012	65 (98.5)	9 (90.0)	.118	275 (99.6)	31 (96.8)	.065
	no	2 (0.6)	2 (4.8)		1 (1.5)	1 (10.0)		1 (0.4)	1 (3.2)	
Degree of knowledge on COVID-19 vaccine	high	332 (97.1)	38 (90.5)	.031	64 (97.0)	10 (100.0)	.577	268 (97.1)	28 (87.5)	.008
	low	10 (2.9)	4 (9.5)		2 (3.0)	0 (0.0)		8 (2.9)	4 (12.5)	
Perception of safety of COVID-19 vaccine	high	328 (95.9)	36 (85.7)	.005	63 (95.5)	8 (80.0)	.066	265 (99.3)	28 (87.5)	.034
	low	14 (4.1)	6 (14.3)		3 (4.5)	2 (20.0)		11 (0.7)	4 (12.5)	
Parents' hesitance to receive COVID-19 vaccine themselves	yes	218 (63.7)	29(69.0)	.498	30 (45.5)	3 (30.0)	.358	188 (68.1)	26 (81.3)	.127
	no	124 (32.3)	13(31.0)		36 (54.5)	7 (70.0)		88 (31.9)	6 (18.7)	
Willingness to get vaccinated if the vaccine is paid for	yes	307 (89.8)	15 (35.7)	<.001	60 (91.0)	5 (50.0)	.001	247 (89.5)	10 (31.3)	<.001
	no	35 (10.2)	27 (64.3)		6 (9.0)	5 (50.0)		29 (10.5)	22 (68.7)	
Parents' hesitance for children to receive vaccine	yes	210 (61.4)	36 (85.7)	.002	31 (47.0)	7 (70.0)	.175	179 (64.9)	29 (90.6)	.003
	no	132 (39.2)	6 (14.3)		35 (53.0)	3 (30.0)		97 (35.1)	3 (9.4)	

*p-value < .05; n (%), count (percentage). WTP = willingness to pay; RTP = Reluctant to pay.

Table 3. Independent factors affecting parents' WTP for children's COVID-19 vaccine after binary logistic regression model (N = 384).

Variables	Categories	Parents		Fathers		Mothers	
		p-value	OR (95% CI)	p-value	OR (95% CI)	p-value	OR (95% CI)
Degree of knowledge of COVID-19 vaccine	High vs low	.845	0.87 (0.21–3.60)	/	/	.530	0.61 (0.13–2.85)
	Preventive effect of COVID-19						
	Yes vs No	.091	0.15 (0.02–1.35)	/	/	.132	0.10 (0.00–2.04)
Perception of safety of COVID-19 vaccine	High vs low	.717	0.80 (0.23–2.78)	/	/	.868	1.13 (0.26–4.92)
	willingness to get vaccinated if the vaccine is paid for						
	Yes vs No	<.001	13.77 (6.51–29.11)	.029	6.12 (1.21–31.10)	<.001	16.62 (6.90–40.00)
Parents' hesitancy with children to receive against COVID-19	No vs Yes	.017	3.50 (1.25–9.79)	.171	3.31 (0.60–18.35)	.025	5.00 (1.23–20.42)

OR = odds ratio; CI = confidence interval.

about the side effects of the vaccine. Second, they preferred to wait and first find out what happened to others; very few parents considered it unnecessary to vaccinate their children against COVID-19.

Discussion

Clinical implications

As COVID-19 continues to mutate and vaccine efficacy naturally decays, frequent vaccinations are required to achieve herd immunity.⁹ The COVID-19 vaccine may require out-of-pocket payments in the future, and assessing individuals' WTP not only allows for the development of a payment scheme that balances costs and benefits, it also identifies potential market

demand.⁴ Assessing the optimal WTP value depends on parental acceptance of the COVID-19 vaccine and how much they are willing to pay for the vaccine.¹⁴

We also summarized the WTP for the COVID-19 vaccine of the general population in other countries and found a large variation, ranging from 18.4% to 84.3%, with a minimum WTP of \$1.15 to a maximum of \$159.2 (Table 4). Among them, the WTP in Nigeria and Pakistan (ranging from 18.4% to 33.9%) is significantly lower than the WTP summarized in other countries in Africa and Asia (ranging from 56% to 84.3%).^{17–19,21} The factors that may influence this difference are gender, place of residence, education level, age, religious beliefs (whether the vaccine is halal or not), previous vaccination history with the COVID-19 vaccine, the perceived safety of the vaccine, perceived risk, and time of survey. In

Table 4. The estimates of adults' WTP for the COVID-19 vaccine in Asia and Africa.

Author	Study period	Sample size	Sample range	Country	WTP		
					Percentage	Mean/Median	Reference
Wang et al.	March 3–18, 2020	2,058	adults	China	84.3%	RMB 254 (US\$ 36.80)	3
Harapan et al.	March 25 – April 6, 2020	1,359	public	Indonesia	78.3%	US\$ 57.20	4
Zhang et al.	March – May, 2020	1,179	public	China	81.1%	US\$ 73.40–146.50	15
Karam et al.	June – July, 2020	352	public	Lebanon	78.1%	US\$ 63.70	16
Ilesanmi et al.	September 21–25, 2020	232	15 years and older	Nigeria	18.4%	US\$ 13.16	17
Tahir et al.	September 27 – October 11, 2020	883	public	Pakistan	33.9%	US\$ 7	18
Okafor et al.	October 18–30, 2020	689	adults	Nigeria	22.8%	US\$ 1.20–2.50	19
Kiran et al.	October – December, 2020	3,371	adults	India	68%	NA	20
Banik et al.	December 10, 2020 – January 10, 2021	894	adults	Bangladesh	72.9%	US\$ 4.72	14
Adigwe et al.	January, 2021	1,767	public	Nigeria	26%	US\$ 1.15	21
Kabir et al.	January 20–27, 2021	697	adults	Bangladesh	68.4%	US\$ 7.08	1
Xiao et al.	January 28 – February 5, 2021	2,450	adults	China	77.7%	US\$ 127.60–159.20	22
Seboka et al.	February – March, 2021	1,160	public	Ethiopia	56%	NA	23
Tung et al.	June 9–17, 2021	1,788	parents	China	66.1%	< RMB 200 (US\$ 29.70)	9
Mueangpoon et al.	September 13, 2021 – January 14, 2022	705	adults	Thailand	77.2%	US\$ 14.30–28.50	24

NA = Not available; relevant studies were searched in the Cochrane Library, PubMed, and EMBASE databases, from inception to August 21, 2022. The search included key concepts such as WTP and the COVID-19 vaccine. Titles and abstracts were scanned, irrelevant literature was filtered out, and duplicates were removed, resulting in 15 relevant papers.

addition, income and whether someone close to them contracted COVID-19 (experience related to COVID-19) are related to WTP for vaccination.^{2,25–27} However, these factors were not adequately investigated and our study found that gender, place of residence, education level, and previous vaccination history did not significantly affect parents' WTP for their children. It is necessary to further explore whether parental income and experience related to COVID-19 influence WTP.

Interestingly, we also summarized the WTP for COVID-19 vaccination of the general population in mainland China. In the four cross-sectional studies conducted in China, the surveys occurred in the first six months after the emergence of COVID-19, and the prolonged global outbreak and seriousness of the situation increased the sense of urgency and awareness of the seriousness of COVID-19 among individuals.^{3,15,25,28} Therefore, the WTP for the COVID-19 vaccine was also relatively high, which is consistent with two studies conducted in Chile at different times.^{29,30} In May 2021, the first large outbreak of COVID-19 hit Taiwan;³¹ although the survey period of our study was not at the time of the outbreak, a high percentage (89.1%) of parents were still happy to pay for their children's vaccination, considering that the first large outbreak in Taiwan only happened two years after the global COVID-19 pandemic. After two years, there has been a significant increase in COVID-19 awareness and the COVID-19 vaccine in Taiwan. Previous studies show that knowledge of COVID-19 vaccines is associated with a significantly higher WTP.^{7,9} In the same way, two study in Malaysia showed that the more knowledgeable parents were about vaccines, the more positive their attitudes and perceptions about vaccination were.^{32,33}

Clinical practices

In our findings, 89.1% of parents wanted to pay for their children, indicating a high level of parental acceptance of the COVID-19 vaccine for children in Taiwan, higher than

that of Bangladesh (56%) and India (68%). Interestingly, among the parents who were reluctant to receive the COVID-19 vaccine, 56.5% were still happy to pay for their children. The reason for the difference in parents' WTP for themselves and their children may be that parents in China believe that the COVID-19 vaccine is of high value in preventing COVID-19 infection. Moreover, they were more pleased to pay for their children to be immunized.

Parents' reluctance to pay for the COVID-19 vaccine for themselves influenced their decision to pay for their children. Parents who agreed to pay for COVID-19 vaccines were mostly willing to pay for their children. However, the possibility of side effects due to the COVID-19 vaccine may also contribute to reluctance among parents who were willing to pay for their children's vaccines. The main factor contributing to parents' hesitation to vaccinate their children is the possible side effects of the vaccines. Previous studies have shown that hesitation about vaccines can strongly influence people's WTP.^{5,8} According to our findings, increasing parents' WTP and reducing their hesitancy to vaccinate their children could help achieve full vaccination of children.

It has been shown that improved vaccination rates among children and developing herd immunity can be achieved through public pressure and private funding, as was evident for the influenza vaccine in Chile.³⁴ The government in Chile provides an influenza vaccine free of charge to high-risk groups (children under six years of age, pregnant women, chronically ill patients, and older adults), while others must pay their own way.³⁵ Thus, government provision of the vaccine to vulnerable groups (including low-income and severely co-morbid groups) can greatly increase vaccination rates. In addition, occasional dissemination of information about the COVID-19 vaccine can reduce parents' hesitation to vaccinate their children and increase their WTP for their children.

Our study provides insight into parents' WTP for COVID-19 vaccine for their children and for themselves. By increasing

parents' WTP for their own vaccinations, they further promote their WTP for their children, thereby increasing child vaccination rates.

Methodological considerations

The current study had some limitations. First, the use of an online anonymous survey may produce multiple sampling biases; we collected a sample of predominantly urban residents, households with high education levels, and stable economic resources, and the results of data analysis are not generalizable. Such sampling errors may alter the observed WTP. Second, 43% of the participants were HCWs. Given that this population has greater knowledge and acceptance of the vaccine, this may bias the study data and its results may not be fully extrapolated to the general population. Third, this was a cross-sectional study, which can only reflect the situation at a specific point in time. During the questionnaire period, the number of newly confirmed cases in Taiwan increased daily, but not during the pandemic. Our estimates were made at only one point in time, and it is uncertain how people's attitudes changed as the epidemic changed. Furthermore, vaccines are currently available free of charge in most countries, the perception of paying for vaccines is insufficient, and the WTP survey will differ from the actual WTP.

Conclusion

Our survey results showed that a high percentage (89.1%) of parents in Taiwan were happy to pay for their children's COVID-19 vaccine. Parents' WTP for themselves and their hesitation to vaccinate their children are both related to their WTP. Enhancing vaccine knowledge, reducing hesitation about vaccines, and the development of vaccine payment policies have positive implications for increasing WTP for vaccines and promoting vaccination.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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ORCID

Xiao-Qing Lin  <http://orcid.org/0000-0003-4986-2835>
Tao-Hsin Tung  <http://orcid.org/0000-0003-2097-8375>
Jian-Sheng Zhu  <http://orcid.org/0000-0002-4961-7437>

Author contributions

J.S.Z. and T.H.T. conceived the study and designed the questionnaire. J.Y.C. collected the data. C.L.H. was responsible for analyzing and writing the first draft of the paper. C.L.H., C.Q.Y., and J.S.D. searched, sorted, and

interpreted the relevant literature. All authors edited and approved the final manuscript.

Data availability statement

The data used for this study, although not available in a public repository, will be made available to other researchers upon reasonable request.

Ethics approval and consent to participate

We did not require a separate written informed consent because of anonymity. Parental participation in the survey was treated as informed consent. This study was approved by the Ethics Committee of Taizhou Hospital of Zhejiang Province (approval number: K20210520) in China.

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