

Impact of Family Participation on Vaccination Decisions During the Outbreak: An Online Questionnaire Survey of Taiwanese People

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Abstract COVID-19 is the most alarming public health crisis of the century. There have been many studies related to vaccine hesitancy to date. However, most of these studies discussed the influencing factors of vaccination decision-making from a micro level. Further, the influence of the relationship networks on personal decision-making was seldom addressed. This study mainly aimed to explore the acceptance level of the COVID-19 vaccine and its relationship with family participation among the Taiwanese population. An independently-developed questionnaire was used to conduct an online cross-sectional survey during Taiwan's Level 3 alert period from June 30 to July 30, 2021. The study participants were people over 18 years of age and lived in Taiwan. A total of 1 108 participants were ultimately included in the analysis, and the logistic regression model was used for analysis. The study results showed that during Level 3 alert period, the vaccine acceptance level was high in Taiwan, with an overall 88.62% of the participants expressing their willingness to get vaccinated. The COVID-19 vaccination decision (willingness or undecided) was not associated with age, education level, or gender but with family members' participation and participation level. The odds of "participants who would discuss with their families" was 0.596 times that of "participants who do not discuss with their families." Therefore, for a unit increase in the family participation scale score, the odds of being willing to be vaccinated would decrease by 0.789. Specifically, the odds would be reduced by $(0.454-1)*100\% = 54.6\%$.

Keywords: COVID-19, family participation, vaccination decision-making, logistic regression analysis

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1. Introduction

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) first emerged in Wuhan, Hubei Province, China, at the end of 2019 [1]. In January 2021, the first confirmed case outside Asia was found in Seattle, the United States [2]. As of November 1, 2021, the number of deaths caused by COVID-19 has exceeded 5 million worldwide [3,4], which made it the most alarming public health crisis of the century.

The first confirmed imported case in Taiwan was found in January 2020. Based on its successful SARS prevention experience, Taiwan immediately adopted effective measures to combat COVID-19 at the beginning of the outbreak. Such as early screening, effective isolation/quarantine methods, digital technology to identify potential cases, contact tracing, and mandatory mask-wearing [5,6], preventing a comprehensive blockade. Although non-invasive preventive behaviors such as wearing masks and maintaining social distancing have proven to be effective in curbing the spread of SARS-CoV-2 [7], the long-term effective

control method was the development and implementation of preventive vaccines. The vaccination program is still one of the most cost-effective public health interventions to achieve herd immunity. It is often listed as one of the priority strategies for controlling infectious diseases by public health decision-makers [8]. Therefore, vaccination for more than 80% of the population is necessary (Sanche et al., 2020), but this can only be achieved when the public has a high degree of acceptance or low hesitation to vaccination.

The public's attitude toward vaccines does not take the binary form of support and opposition; instead, it is a continuous spectrum between these two extremes [9], such as the acceptance of some/all vaccines, rejection of some/all vaccines, and delayed decision. These "hesitant" people may reject certain vaccines but agree to other vaccines, delay vaccination, or accept vaccines but are not sure whether they will eventually receive vaccines [10,11]. The WHO Strategic Advisory Group of Experts (SAGE) defines the vaccine decision-making behavior of "delaying or rejecting vaccines even if there is a vaccination service" as "vaccine hesitation" [12,13]. The determinants of vaccine hesitation are numerous and vary from case to

case, not only by region and vaccine type [9,12], but also by the interaction between other factors, such as complacency, convenience, and confidence [9].

The public's negative and uncertain attitudes towards vaccines or unwillingness to vaccinate are the biggest obstacles to the long-term management of the COVID-19 pandemic [14]. Therefore, for policymakers in various countries, before launching large-scale vaccination plans, it is necessary to determine the people's attitude toward vaccines and the factors affecting them. The acceptance of the COVID-19 vaccine varies significantly from country to country. According to the current research findings, China's approval of vaccines is the highest at nearly 90%, that of Russia is less than 55% [15], that of the United States is 67% [16], and that of the UK is 64% [17]. In Hong Kong, it is even lower at only 37.2% [18]. Unfortunately, there are few studies on accepting the COVID-19 vaccine in Taiwan. As far as we know, there is only one [19]. The study results show that the Taiwanese people's acceptance of vaccines is lower than in other high-income countries, with only 52.7% of participants willing to receive the COVID-19 vaccine, mainly due to the impact of past vaccination experience. The groups unwilling to accept the COVID-19 vaccine are the elderly, women, and participants with higher education levels. In addition, Taiwanese people's perception of the COVID-19 risk is negatively related to their willingness to receive the COVID-19 vaccine. This is the most significant difference from past research results [20]. Participants who are unwilling to be vaccinated respond to COVID-19 by adopting more non-invasive personal health protection behaviors, such as washing hands, wearing masks, and maintaining a safe social distance.

Although vaccine acceptance is low, this does not mean that Taiwanese people are "vaccine-hesitant" because the study period is from October 19 to 30, 2020. The Taiwan government had not yet obtained a usable COVID-19 vaccine at that time, and the large-scale vaccination plan has not yet started. In addition, at that time, Taiwan was still in a situation of "zero diagnoses in the country." The current study period is from June 30 to July 26, 2021. June 30 is the 43rd day when the country enters the Level 3 alert [4,21], and the mass vaccination plan has been implemented. Those with higher priority could even choose from Moderna and AstraZeneca COVID-19 vaccines. Based on past studies, it is known that vaccine-hesitant behavior will vary with time, location, and vaccine [22]. Thus, during the rapid increase in the number of people infected in Taiwan (when the pandemic was relatively severe), we conducted this nationwide survey to understand the people's decisions about vaccination against COVID-19. Do these demographic variables still have statistical explanatory power? This is the first research purpose of this study.

At the beginning of 2021, novel vaccines against COVID-19 were marketed through the emergency authorization of governments of different countries. The side effects, efficacy, and safety of the vaccines were not only the primary concerns of scientists [23,24,25,26]. Nonetheless, they were also essential reference indicators for the general population's willingness to be vaccinated. In addition, people's vaccination decisions were

influenced by demographic, social, and background factors [27], health information sources, as well as personal political ideologies [9,28,29]. In this study, we were curious about whether the personal network that an individual was embedded in impacted personal decision-making apart from the above factors. Since the Taiwanese culture followed the Confucian family ethics [30], that the relationship between the individual and family was close with a sense of common obligations [31], individuals often relied on family members' opinions when facing major medical decisions [32,33,34], even if the individual was able to make decisions independently. Family members play multiple vital roles and are the most important source of social support for most people [35]. They not only provided information support during the medical decision-making process but were also essential decision-making partners for individuals [36]. However, the research related to vaccine decision-making lacked the discussion of family participation. Therefore, this study investigated whether participants would fully communicate with their relatives and family members during decision-making and the level of family participation to assess the impact of family participation on vaccine decision-making. This was the second purpose of this study.

In summary, the specific research questions of this study were (1) Assessing the vaccination decision-making of Taiwanese people during the Level 3 alert period; and (2) Understanding the relationship between family participation, family participation level, and vaccine decision-making.

2. Materials and Methods

2.1. Research Design

This is a cross-sectional study, and the study period is from June 29 to August 8, 2021. The Taiwan Centers for Disease Control and Prevention (TCDC) of the Taiwan Ministry of Health and Welfare raised the pandemic alert to Level 3 from May 19 until July 27. During this period, systematic nationwide sample surveys could not be conducted, and online surveys were the most suitable method for evaluating large populations. Therefore, we used the Survey Cake platform to collect data online.

The first page of the questionnaire is general information such as the purpose of the research and the consent statement. Participants are residents who are over 18 years old and live in Taiwan.

In reaching participants from different age groups, areas of residence, and industries, this study also adopted various strategies to recruit questionnaire participants, including contacting community leaders and influencers on social media through personal networks of researchers and relatives, and friends to share this questionnaire. The reason for using the Facebook and Line platforms to disseminate online questionnaires is that the personal Internet access rate of all people over 12 years old in Taiwan is 86.2% [38]. Further, the survey report of the Council of Information pointed out Facebook and Line are the two most frequently used platforms by more than 80% of Taiwanese people [6].

According to the visitor record data provided by the Survey Cake platform, a total of 2,950 people visited during the survey period, and 1,114 people completed the survey (the response rate was 37.7%). Excluding incomplete responses, 1,108 participants were eventually included in the analysis. Participants who completed the questionnaire did not receive any prizes or bonuses.

2.2. Measurement

The questionnaire used in this study consists of four parts: (1) Participants' characteristics; (2) Family Participation; (3) Vaccination decisions.

2.2.1. Personal Characteristics

We surveyed participants' social and demographic information, including gender, education level, marital status, age, and monthly salary income.

2.2.2. Family Participation

This study first categorized the participants with a question item to assess the participation level of family members, "Will you fully communicate and discuss with relatives and family members when deciding whether to get vaccinated?" The options were "Yes" and "No." Participants who responded "Yes" would answer the following question set.

The Family Participation Scale was independently developed in this study after reviewing relevant literature on family participation in medical decision-making [32,33,35,36]. There were five questions: "I would pass the vaccine-related information I collected to other family members." "During the decision-making process, I would discuss with my family to reach a consensus." "During the decision-making process, my family members' opinions are more important than the doctor's." "During the decision-making process, the family's opinions are more important than the government's official propaganda." Finally, "During the decision-making process, my family is a joint decision-maker." Responses were rated on a 6-point Likert-type scale, with "1 = Strongly disagree, 2 = Disagree, 3 = Slightly disagree, 4 = Slightly agree, 5 = Agree, and 6 = Strongly agree". The total average score was the score of the dimension, and a higher score indicated a higher level of family participation.

Reliability analysis of the Family Participation Scale showed that the internal consistency coefficient Cronbach's alpha was 0.616, which became 0.654 after removing the first question, "I would pass the vaccine-related information I collected to other family members." The Cronbach's alpha was between 0.65 and 0.7, indicating minimally acceptable reliability [38].

2.2.3. Intention of Vaccination Decisions

To measure the vaccination decision, we asked, "When you can have the new coronavirus vaccine, are you willing to get the vaccine?" The options were "Yes," "Not yet decided, still waiting," and "Unwilling."

2.3. Statistical Analyses

All results of quantitative variables were reported either as mean (M), standard deviation (SD), or frequency

(percentage %). All results of qualitative variables were reported frequency (percentage %).

The Chi-square independence test was used to determine whether individual factors, such as age group, gender, marital status, education level, monthly salary income, are related to the vaccination decision.

The Pearson Chi-square test statistics was used for unordered category variables (such as gender, marital status, source of information). However, when the Chi-square test was performed on ordered category variables (such as age group, education level, monthly salary income), the M2 tests were used.

Binary logistic regression was used to analyze the correlation between vaccination decisions and socio-demographic variables, family participation. The odds ratios (ORs) and 95% confidence intervals (CIs) were also calculated, and the significance level was set at 0.05.

In data processing, we first merged the groups in the cross table with less than five or less than 5% of the subdivisions. For example, regarding gender, the number of "neutral/transgender" is less than five, and the group is included in the "Male" group. In terms of vaccination decision-making, only 17 participants (1.53%) expressed "unwillingness," thus, they were merged into "not yet decided, still waiting" (9.84%).

All statistical analyses were conducted in SPSS version 28 (IBM, Armonk, NY, USA).

3. Result and Discussion

3.1. Descriptive Statistics

A total of 2,950 people visited the online questionnaire, and 1,114 people completed the survey, with a response rate of 37.7%. After excluding the questionnaires with incomplete responses due to the adjustment of questions, 1,108 participants were finally included in the analysis.

Overall, the age of participants ranged from 18 to 78 years, with an average age of 43.19 years (SD=11.096). More than half of the participants were women (58.1%). In addition, 57.9% of the participants were married, and 34.2% were single and unmarried. In terms of education level, 61.8% have a university (college) degree, followed by 20.4% with a graduate degree or above. In terms of income, 34.5% of participants' monthly salary income ranged from NT\$24,000 to 44,000, followed by below NT\$24,000 (22.7%), and between NT\$44,000 and 64,000 (21.8%).

Regarding family participation, for the question "Will you fully communicate and discuss with relatives and families when deciding whether or not to get vaccinated?" there were only 256 participants who answered "No." Participants who responded "Yes" continued to the Family Participation Scale, calculated as the average score of the four questions. The family participation scores of the 852 participants (76.9% of all participants) ranged from 2 to 6, with an average score of 4.01 (SD = 0.804).

Finally, in terms of vaccination decisions, among the 1,108 participants, nearly 90% (88.62%) expressed their "willingness" to be vaccinated.

3.2. The Relationship between Personal Characteristics and Vaccination Decisions

Table 1 presents the results of the Chi-square test analysis, showing that the people's vaccination decision (willing/undecided) was independent of gender, education level, age group, and monthly salary income. Simultaneously, it was related to family participation or not.

3.3. Impact of Family Participation on Vaccination Decisions

The Chi-square test result cannot demonstrate the strength of the correlation between family participation and vaccination decisions. Therefore, a univariate logistic regression analysis was carried out. The participants' vaccine decision was regarded as a binary criterion

variable. Whether to discuss vaccine decisions with family members was regarded as a binary criterion variable and was coded as 1 = "Willing to be vaccinated," 0 = "Not yet decided." The dichotomous predictive variable of whether family members participated or not was coded as 0 = "Will not discuss with family members" and 1 = "Will discuss with family members." The analysis results of the SPSS statistical software were collated in Table 2.

In Table 2, the regression coefficients, S.E, and p-value showed that the prediction of "family participation" on "vaccine decision-making" was statistically significant. The "not discussing with family" group was used as the reference group, and the coefficient of family participation was -.571, with an odd of .596. This indicated that the odds of "participants who would discuss with their family members" were 0.596 times that of "participants who would not discuss with their family members"; in other words, the odds were reduced by $(1 - 0.571) * 100 = 42.9\%$.

Table 1. Essential demographic characteristics affecting COVID-19 vaccine uptake intention

Variables	Total (n=1108)		Willing (n=982)		Undecided ^a (n=126)		p-Value
	n	%	n	%	n	%	
Gender (n=1108)							
Male	464	41.9%	419	42.7%	45	35.7%	0.136
Female	644	58.1%	563	57.3%	81	64.3%	
Education (n=1108)							
High school and below	197	17.8	176	17.9	21	16.7	0.679
College	685	61.8	607	61.8	78	61.9	
Master and above	226	20.4	199	20.3	27	21.4	
Marital status (n=1108)							
Single	379	34.2	335	34.1	44	34.9	0.981
Married	642	57.9	570	58.0	72	57.1	
Other ^b	87	7.9	77	7.8	10	7.9	
Age group (Mode=42, Mean=43.19, SD=11.096, Range=18-78) (n=1108)							
18-39	421	38.0	384	39.1	37	29.4	0.122
40-59	592	53.4	513	52.2	79	62.7	
Above 60	95	8.6	85	8.7	10	7.9	
Monthly Income (n=1108)							
Less than NT24,000	251	22.7	215	21.9	36	28.6	0.430
NT24,000~ NT44,000	382	34.5	337	34.3	45	35.7	
NT44,000~ NT64,000	242	21.8	226	23.0	16	12.7	
NT64,000~ NT84,000	115	10.4	103	10.5	12	9.5	
More than NT84,000	118	10.6	101	10.3	17	13.5	
Family Participation (n=1108)							
Yes	852	76.9%	746	75.97%	106	84.13%	0.014*
No	256	23.1%	236	24.03%	20	15.87%	

a Undecided included 17 "Unwilling" participants

b Other include cohabitation/divorced/separated/spouse deceased

*p<0.05 **P<0.01 ***P<.001.

Table 2. Univariate logistic regression model of family participation (categorical variable) and vaccination decision-making

Estimated Odds Ratio of Willingness to vaccinate COVID-19 Vaccination						
Variables	B	S.E	Exp(B)	95% C.I. for Exp(B)	p-Value	
Step 0	Constant	2.053	.095	7.794	.000	
Step 1	Family Participation	-.571*	.255	.596	(.362 - .983)	0.043
	Constant	2.468	.233	11.8		

Cox & Snell R²=0.004; Nagelkerke R²=0.008; Percent Correct=88.6%

*p<0.05 **P<0.01 ***P<.001.

The simple logistic regression model is shown as follows:

$$\hat{Y} = \frac{1}{1 + e^{-(2.468 - 0.571 * FP)}}$$

After taking natural logarithms on both sides and linear transformation, the linear regression equation can be expressed as follows:

$$\text{Logit}(\hat{Y}) = 2.468 + (-0.571) * \text{Family participation}$$

Family participation = 1 was substituted into the equation, that is, the odds = $e^{(2.468 - 0.571 * (1))} = e^{1.897} = 6.67$ for “participants who would discuss with family members.” In other words, participants who would discuss with their family members were 6.67 times more likely to decide to be vaccinated than not yet decided. When family participation = 0, that is, for “participants who would not discuss with family members,” the odds = $e^{(2.468 - 0.571 * (0))} = e^{2.468} = 11.799$. Specifically, participants who did not discuss with their family members were 11.799 times more likely to decide to be vaccinated than not yet undecided.

We could also convert odds to probability, and the following can be obtained: for “participants who would discuss with family members,” $\hat{Y} = \frac{ODD_s}{1 + ODD_s} = \frac{6.67}{7.67} = 86.96\%$.

In other words, our model predicted that 86.96% of “participants who would discuss with their family members” were willing to be vaccinated. Similarly, the model predicted that 92.19% of “participants who would not discuss with their family members” were willing to be vaccinated.

3.4. Family Participation Level and Vaccination Decision-making

Before receiving the vaccination, the participants who “would” discuss with their family members (852) continued to complete the Family Participant Scale. A simple Logistic regression model was also used to analyze the intensity of the relationship between vaccination decisions and family participation levels. The analysis results are summarized in Table 3.

Table 3. Univariate logistic regression model of family participation level (continuous variable) and vaccination decision

Estimated Odds Ratio of Willingness to vaccinate COVID-19 Vaccination					
Variables	B	S.E	Exp(B)	95% C.I. for Exp(B)	p-Value
Step0 Constant	1.951	.104	7.038		.000
Step1 Family participation level	-.789***	.133	.454	(.350 –.590)	.000
Constant	5.264***	.593	193.3.4		

Cox & Snell R²=.042; Nagelkerke R²=.080; Percent Correct=87.6%; Hosmer & Lemeshow test p=.057

The analysis results showed that family participation was a significant variable in predicting the participants’ vaccination decisions (willing or undecided). Therefore, a simple logistic regression model was built as follows:

$$\hat{Y} = \frac{1}{1 + e^{-(5.264 - 0.789 * \text{Family participation level})}}$$

After taking the natural logarithms on both sides and linear transformation, the linear regression equation can be expressed as follows:

$$\text{Logit}(\hat{Y}) = 5.264 - 0.789 * \text{Family participation}$$

For each unit increase in the Family Participation Scale, the odds of being willing to be vaccinated decreased by 0.789, or in other words, the odds were reduced by $(0.454 - 1) * 100\% = 54.6\%$.

4. Discussion

This study has two purposes. The first is to understand the acceptance of the COVID-19 vaccine by the Taiwanese people during the Level 3 alert period when two vaccines were available and to explore possible influencing factors. The second was to assess the impact of family participation and family participation level on the general population’s decision on COVID-19 vaccination.

To the best of our knowledge, only one study in Taiwan explores the public’s acceptance of the COVID-19 vaccine [19]. The results show that only 52.7% of the participants in Taiwan are willing to receive the COVID-19 vaccine. It is lower than other high-income countries, such as France and Sweden, and the low acceptance is mainly due to the impact of past vaccination experience. However, the samples collected in this study through online questionnaires show that the public’s acceptance of vaccines has changed significantly. During the Level 3 alert period from June 30 to July 30, 2021, the rate of people willing to be vaccinated was 88.62%, which was much higher than the acceptance level during the Level 2 alert period in October 2020 [19]. In addition, the results of this study show that the two categories of “willing and not yet determined to receive COVID-19 vaccine” have nothing to do with gender, education level, marital status, and age and are different from the results of previous studies in Taiwan [19]. This phenomenon may be caused by the rapid increase in the number of infections in Taiwan during the study period [21]. We speculate that the possible reason for this phenomenon is that when people perceive the pandemic to be relatively severe, personal health protection behaviors (washing hands, wearing masks, and maintaining social distancing) may not be able to cope with COVID-19. Thus, they would increase acceptance of the vaccine against COVID-19, even though these vaccines may have strong side effects on specific ethnic groups [39].

Regarding family participation, the chi-square test result was whether the participant “would discuss with family members” was related to the “vaccine decision.” Participants who would discuss with their family members were 6.67 times more likely to decide to get vaccinated than undecided, and participants who did not consult with their family members were 11.799 times more likely to choose to get vaccinated than indecisive. This result was in line with the expectations of this study.

However, the influence of family participation level on decision-making was for every one-unit increase of the score of the Family Participation Scale, the odds of willingness to be vaccinated decreased by $(0.454 - 1) * 100\% = 54.6\%$. This result was beyond the expectations of this study, which required further investigation.

5. Limitation

This study has several limitations. First, although the use of online questionnaires as the survey instrument broke the limitations of time and space, it remained difficult for the elderly to complete the online questionnaires on various carriers, resulting in a relatively low proportion of elderly participants. Second, the total population of Taiwan as of May 2021 was 23,499,070, with 11,640,336 males (49.54%) and 11,858,734 females (50.46%). The chi-square goodness of fit test result showed that the gender ratio of the sample was significantly different from the gender ratio of the whole population. Therefore, the sample was not suitable for making generalized statistical inferences. Third, we might not rule out reporting bias due to the data collection method. Fourth, since there was no applicable scale, this study adopted an independently-developed Family Participation Scale, with an internal consistency coefficient Cronbach's alpha of 0.654. A higher Cronbach's alpha value indicated that the test questions measured the same feature, which suggested higher reliability. However, the reliability of the independently-developed test questions in this study was between 0.65 and 0.7, which was minimally acceptable [38] and was a study limitation.

6. Conclusion

This study showed that during Level 3 alert period, the vaccine acceptance level in Taiwan was relatively high. The COVID-19 vaccination decision (willing or undecided) was not associated with age, education level, or gender. Nonetheless, it was related to the participation of family members and the level of family participation. As the culture in Taiwan remains heavily influenced by Confucianism, individuals would discuss significant decisions with their family members and adopt their opinions. Therefore, to increase people's willingness to vaccinate, we recommended that the content and process of vaccination program services be planned on a family basis. The factors influencing families when making vaccination decisions should be further explored.

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