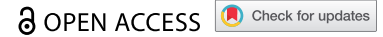


SHORT REPORT



Theory of planned behavior explains males' and females' intention to receive COVID-19 vaccines differently

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ABSTRACT

Uptake of COVID-19 vaccines is an important measure to curb the transmission of the coronavirus. Before the vaccines were available, numerous studies found that people had a moderate-to-high intention to receive the vaccines. Several studies have also used the theory of planned behavior (TPB) to predict people's COVID-19 vaccination intention with three elements (i.e. attitudes, subjective norms, and perceived behavioral control). However, the vaccination rate falters after the vaccines became available, and there were few updated data documenting people's vaccination intention and how well TPB can explain their intention. In addition, studies investigating other outcomes found that the predictive utilities of TPB often varied across gender, but such gender differences received little consideration in the literature of COVID-19 vaccination intention. To help fill these gaps, we examined the associations between TPB elements and people's intention to receive COVID-19 vaccines and the moderation of gender in the context of vaccination campaign. Participants were 405 Chinese citizens. They reported on the three TPB elements and intention to receive vaccines in the coming months. Descriptive results showed that participants' vaccination intention was moderate. Results of path analysis showed that subjective norms and perceived behavioral control were positively related to vaccination intention for the whole sample. Furthermore, results of multigroup path analysis showed that attitudes were only related to males', while subjective norms were only related to females', intention. These findings enhance the utility of TPB in explaining people's COVID-19 vaccination intention and inform gender-specific strategies to boost males' and females' vaccination intention.

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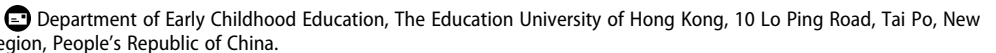
To receive vaccines is a crucial measure to stop the 2019-coronavirus (COVID-19) and reduce the mortality.¹ Before the COVID-19 vaccines (hereafter "vaccines") were available, various survey studies found that people from different nations expressed keen intention to receive vaccines.²⁻⁵ However, the rate of vaccination has been faltering since the vaccines became available. For instance, when this survey was being conducted in late July 2021, the global rate of full vaccination was only 11%, and the figure was still lower than 50% by the end of 2021.⁶ This phenomenon leads to an important question: what factors affect people's intention to receive or not to receive vaccines? Addressing this question will inform the leverage points that can be targeted to boost the vaccination rate.

The theory of planned behavior (TPB) has been used to explain people's intention to receive COVID-19 vaccines,⁷ but there are two gaps that await further investigation. First, most studies were conducted *before* the vaccines were available, updating the findings of this line of research *after* the vaccines became available is necessary because people's vaccination intention can be changed depending on the information about the vaccines they receive, and on the responses other people may have. Second, prior studies found that TPB explained males' and female's intention and behavior of other outcomes differently,⁸⁻¹⁰ but such gender

differences have received much less research in the literature of COVID-19 vaccination intention. This knowledge gap hinders the utility of TPB in explaining people's COVID-19 vaccination intention and the development of tailor-made intervention strategies. In this study, we sought to fill the said gaps by examining people's intention to receive vaccines from the perspectives of TPB and the moderation of gender in a sample of Chinese participants when the vaccination campaign was being implemented.

TPB and COVID-19 vaccination intention

TPB has been widely used to predict the change of intention and behavior in numerous domains.¹¹⁻¹⁵ According to Ajzen,¹⁶ TPB proposes that the most powerful determinant of a behavior is the intention to engage in that behavior. The theory also postulates that the intention to enact a certain behavior is determined by three core elements, namely *attitudes* (i.e., sum of the positive/negative valence of each estimated outcome/experience of the behavior), *subjective norms* (i.e., whether others approve of or also enact the behavior), and *perceived behavioral control* (i.e., sum of a person's control belief over the factors that hinder or facilitate the enactment of the behavior). Of note, prior studies have suggested self-

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efficacy as a proxy of perceived behavioral control, as both concepts reflect the extent to which people are capable of executing the behavior.^{7,17,18} In sum, when an individual has positive attitudes toward a certain behavior, strong normative beliefs about it, and a sense of control, he/she will have a stronger intention and will be more prone to enact that behavior.

Several studies have used TPB to examine people's intention to receive vaccines *before* the vaccines were available. For instance, Chu and Liu found that positive attitudes and strong subjective norms were related to stronger intention to receive vaccines in US participants whereas perceived behavioral control (as measured by self-efficacy scale) was not.¹⁷ In Hossain et al.'s study, they found that all the three TPB elements were negatively related to vaccine hesitancy.¹⁹ Shmueli's survey conducted in Israeli public found that subjective norms and perceived behavioral control (as measured by self-efficacy scale) were the two TPB elements distinguishing those who intended to receive vaccines and those who intended not to.²⁰ After the vaccines became available, only a few studies have been done to examine vaccination intention. Fan et al. found that Chinese university students' intention to receive vaccines was related to attitudes, but not related to subjective norms or perceived behavioral control.²¹ However, Fan et al.'s research did not distinguish those who had and had not received vaccines, thus causing potential bias. Li et al.'s study found that attitudes and subjective norms were related to parents' intention to vaccinate their children, but the study did not focus on the people's intention to receive vaccines themselves.⁷ In this study, we contributed to this trendy, yet understudied, topic by examining the associations between TPB elements and intention to receive vaccines after the vaccines were available among a sample of Chinese publics who had not received vaccines.

Gender differences in the associations between TPB elements and intention to receive vaccines

A recent meta-analysis revealed significant gender differences in intention to receive vaccines, with males reporting more likelihood to receive vaccines compared to females.²² As such, it would be promising to examine whether gender would moderate the strengths of the associations between TPB elements and people's intention to receive vaccines. The role of gender in the links between TPB elements and intention to engage in a certain behavior has been investigated in past literature. For instance, a study found that the associations between attitudes toward alcohol and alcoholic consumption were stronger among females than males.⁸ Another study found that attitudes toward physical activity were only related to boys' but not girls' intention to engage in physical activities.⁹ Morris et al. found that men were strongly influenced by attitudes toward using technology than females.¹⁰ These findings suggest that the three TPB elements may relate to males' and females' intention and actual behavior differently. However, gender has been predominantly treated as a covariate in the existing studies about COVID-19 vaccination intention, and whether it plays a moderating role remains largely unexplored. This study also aimed to fill this void.

The current research

In sum, this study aimed to examine two research questions: (1) the extent to which TPB elements would be related to people's intention to receive vaccines, and (2) the extent to which gender would moderate the said associations. Regarding the first question, we hypothesized that positive attitudes toward vaccines, strong subjective norms, and strong perceived behavioral control would be related to stronger intention to receive vaccines. The second question was examined as an exploratory issue due to lack of sufficient evidence.

Methods

Participants and procedures

This study was part of a large survey that aimed to investigate Chinese people's intention/motivation of getting COVID-19 vaccines and its correlates. We used snowball sampling to recruit participants in China from 23/July to 12/August 2021 via internet, with the assistance of 168 student helpers from various regions of China volunteering to spread an online survey link on different social media platforms (e.g., WeChat). A total of 3,273 participants responded to our survey, and those without receiving COVID-19 vaccines constituted the current sample ($N = 405$, $M_{\text{age}} = 19.72$ years, $SD = 7.92$; 35.6% males; 83.7% students). Among the final sample, 4 participants reported that they were ever confirmed/suspicious cases or friends and/or relatives of the confirmed cases; 43 participants reported that they had a history of physical illness and 9 reported a history of psychiatric illness. The study was approved by the ethical committee of the first author's affiliation. All participants provided electronic consent prior to participation.

Measures

Attitudes toward COVID-19 vaccines

Participants' attitude toward COVID-19 vaccines was measured with a 5-item scale developed by Chu and Liu¹⁷ (e.g., "how much you feel negative/positive for getting vaccinated for COVID-19"). All items were rated on a 5-point scale and a higher score indicates more positive attitudes toward vaccines. Cronbach's α was .92 in this study.

Subjective norms

Subjective norm was assessed with a 3-item scale developed by Chu & Liu¹⁷ (e.g., "Most people who are like me will get vaccinated for COVID-19"). All items were rated on a 5-point scale and a higher score indicates stronger subjective norms of receiving vaccines. Cronbach's α was .84 in this study.

Perceived behavioral control of receiving COVID-19 vaccines

Participants' perception of their ability to control the process of receiving vaccines was measured with three items used in Chu and Liu's study which operationalized perceived behavioral control as self-efficacy due to their conceptual similarities.¹⁷ A sample item is "It will be easy for me to get the vaccines to protect myself from COVID-19". All items were rated on

a 5-point scale and a higher score indicates stronger perceived behavioral control of receiving COVID-19 vaccines. Cronbach's α was .88 in this study.

Intention to receive COVID-19 vaccines

Participants' intention to receive COVID-19 vaccines was assessed with two items specifically designed for this study (i.e., "the possibility for me to receive COVID-19 vaccines recently" and "my intention to receive COVID-19 vaccines recently"). The two items were rated on a 5-point scale and a higher score indicates stronger intention to receive COVID-19 vaccines. Cronbach's α was .78 in this study.

Covariates

We collected several demographic variables as covariates, including gender (1 = males, 2 = females), age, education (from 1 = primary school or below to 5 = postgraduate degree), hometown (1 = urban area, 2 = rural area), their relationship with COVID-19 (1 = related, such as confirmed/suspicious case and/or relatives/friends of the confirmed cases, etc., 2 = not related), history of physical illness (1 = yes, 2 = no), history of psychiatric illness (1 = yes, 2 = no), and their physical health condition (from 1 = very poor to 5 = very good).

Statistical analysis

First, we used SPSS 26.0 to calculate descriptive statistics and bivariate correlations among the study variables. Second, we used Mplus 8.3 to examine the associations between attitudes, subjective norms, perceived behavioral control, and intention to receive vaccines for the total sample, controlling for the above-mentioned covariates. Third, we examined whether gender moderated the said associations using the "model constraint" function in Mplus based on measurement invariance of TPB elements across gender.

Results

Preliminary analysis

Results of descriptive statistics and bivariate correlations of the main study variables are displayed in Table 1. The results showed that participants reported high levels of positive attitude (4.59/5), subjective norms (4.14/5), and perceived behavioral control (4.08/5) and moderate levels of intention to receive vaccines (3.65/5). All the bivariate correlations were positive and significant.

Table 1. Descriptive statistics, Cronbach's α , and bivariate correlations of key variables.

	1	2	3	4
1.Attitudes toward vaccines	-			
2.Subjective norms	0.43***	-		
3.Perceived behavioral control	0.45***	0.47***	-	
4.Intention to receive vaccines	0.33***	0.47***	0.46***	-
<i>M</i>	4.59	4.14	4.08	3.65
<i>SD</i>	0.62	0.75	0.70	1.10
Skewness	-1.62	-0.59	-0.35	-0.64

*** $p < 0.001$.

Table 2. The associations between TPB elements and intention to receive vaccines among the overall sample.

	Intention to receive vaccines ($R^2 = 0.33$)			
	<i>B</i>	<i>SE</i>	<i>p</i>	95%CI
Key variables				
Attitudes toward vaccines	0.15	0.10	.110	[-0.025, 0.350]
Subjective norms	0.41	0.09	<.001	[0.247, 0.584]
Perceived behavioral control	0.43	0.09	<.001	[0.257, 0.610]
Covariates				
Gender ^a	-0.01	0.10	.900	[-0.196, 0.185]
Age	0.00	0.01	.526	[-0.007, 0.014]
Education ^b	0.08	0.05	.069	[-0.007, 0.168]
Hometown ^c	0.07	0.09	.489	[-0.123, 0.246]
Relation with COVID-19 ^d	-0.18	0.42	.663	[-0.955, 0.787]
History of chronic physical illness ^e	0.34	0.19	.076	[-0.023, 0.735]
History of psychiatric illness ^f	-0.37	0.38	.326	[-1.074, 0.407]
Current physical health status	0.15	0.06	.018	[0.027, 0.268]

^aGender: 1 = males, 2 = females.

^bEducation: 1 = primary school and below, 2 = middle school degree, 3 = college diploma, 4 = bachelor's degree; 5 = postgraduate degree.

^cHometown: 1 = urban area, 2 = rural area.

^dRelation with COVID-19: 1 = related, 2 = not related.

^eHistory of chronic physical illness: 1 = yes, 2 = no.

^fHistory of psychiatric illness: 1 = yes, 2 = no.

The associations between TPB elements and people's intention to receive COVID-19 vaccines in the total sample

The model explained 32.6% variances of participants' intention to receive vaccines. The results are summarized in Table 2. After controlling for demographic variables, subjective norms ($B = 0.41, p < .001$) and perceived behavioral control ($B = 0.43, p < .001$) were positively associated with intention to receive vaccines. However, positive attitudes ($B = 0.15, p = .110$) was not significantly associated with intention to receive vaccines.

Table 3. Measurement invariance of the TPB measures.

	χ^2	<i>df</i>	CFI	Δ CFI	SRMR	RMSEA (90%CI)
Attitudes toward vaccines						
M1 Configural invariance	8.815	6	0.999	-	0.012	0.048 [0.000, 0.110]
M2 Metric invariance	9.307	10	1.000	0.001	0.021	0.000 [0.000, 0.072]
M3 Scalar invariance	17.737	14	0.998	-0.002	0.030	0.036 [0.000, 0.081]
Subjective norms						
M1 Configural invariance	0.000	0	1.000	-	0.000	0.000 [0.000, 0.000]
M2 Metric invariance	1.877	2	1.000	0	0.042	0.000 [0.000, 0.136]
M3 Scalar invariance	6.628	4	0.995	-0.005	0.055	0.057 [0.000, 0.130]
Perceived behavioral control						
M1 Configural invariance	0.000	0	1.000	-	0.000	0.000 [0.000, 0.000]
M2 Metric invariance	6.539	2	0.993	-0.007	0.088	0.106 [0.021, 0.201]
M3 Partial measurement invariance	0.164	1	1.000	0.007	0.015	0.000 [0.000, 0.138]
M4 Scalar invariance	1.929	3	1.000	0	0.027	0.000 [0.000, 0.100]

Table 4. The associations between TPB elements and intention to receive vaccines by gender.

Paths	Males (N = 144)				Females (N = 261)				Comparison			
	B	SE	p	95% CI	B	SE	p	95% CI	B	SE	p	95% CI
Att→Int	0.462	0.166	.005	[0.142, 0.785]	0.008	0.106	.942	[-0.199, 0.211]	0.454	0.196	.021	[0.095, 0.860]
SN→Int	0.032	0.187	.862	[-0.340, 0.394]	0.565	0.098	<.001	[0.379, 0.763]	-0.532	0.212	.012	[-0.954, -0.124]
PBC→Int	0.504	0.166	.002	[0.167, 0.823]	0.387	0.103	<.001	[0.197, 0.602]	0.117	0.195	.549	[-0.293, 0.483]

Att: Attitudes toward vaccines.

SN: Subjective norms.

PBC: Perceived behavioral control.

Int: Intention to receive vaccines.

Covariates were controlled for but not shown in the table for simplicity.

The moderation of gender

As shown in Table 3, measures of positive attitudes, subjective norms, and perceived behavioral control showed configural, metric, and scalar invariance across gender, as the decrease of CFI was less than .01 and the increase of RMSEA was no greater than .015 between the two models (i.e., configural vs. metric, and metric vs. scalar) while other fit indices were acceptable²³ (i.e., RMSEA and SRMR <.08, CFI >.90). Based on this, we further examined the moderation of gender.

The model explained 35.7% variances of the intention to receive vaccines in males. As depicted in Table 4, positive attitudes and perceived behavioral control were positively associated with intention to receive vaccines, but subjective norms were not. Regarding females, the model explained 36.2% variance of intention to receive vaccines. Subjective norms and perceived behavioral control were positively associated with intention to receive vaccines, but positive attitudes were not.

Further comparing the strengths in the three paths between males and females, we found that the association between attitudes and intention to receive vaccines was significantly stronger for males than females whereas the association between subjective norms and intention to receive vaccines was significantly stronger for females than males. The strength of the association between perceived behavioral control and intention to receive vaccines was not significantly different across gender.

Discussion

Although several studies have used TPB to explain people's intention to receive vaccines before the vaccines were available,^{17,19,20} only a few updated data have been available since the vaccines became available.²¹ This study contributed to this trendy topic by providing updated data from the Chinese public. More importantly, this study also examined an underexplored topic—whether the associations between TPB elements and COVID-19 vaccination intention were moderated by gender. In this study, we found that the levels of Chinese people's intention to receive vaccines were moderate and that subjective norms and perceived behavioral control were positively related to vaccination intention while attitudes were not, which partially confirmed our first hypothesis. Regarding the second question which was exploratory in nature, we found that positive attitudes were only related to stronger intention to receive vaccines among males while stronger subjective norms were only related to stronger intention to receive vaccines among females. These findings contribute to the application of TPB in understanding people's intention to receive vaccines and inform relevant strategies to boost people's vaccination intention.

The TPB considers that all the three elements are important predictors of people's intention and behavior.¹⁶ To the best of our knowledge, only one study has found that all the three TPB elements were related to people's COVID-19 vaccination intention¹⁹ whilst most existing studies revealed only part of the elements were related to people's intention.^{17,20,21} The current findings are in accordance with the majority of the studies, but there are also some differences. For instance, Chu and Liu's study showed that perceived behavioral control was not related to US people's intention¹⁷ while Shmueli's study found that attitudes were not related to Israeli people's intention.²⁰ In Fan et al.'s study conducted in Chinese university students *after* the vaccines became available, only attitudes were the significant correlate. Our current findings were similar to Shmueli's study—attitudes were not a significant correlate, but the other two elements were. These differences are not uncommon due to methodological variations, such as differences in population, data collection periods, and measures that assess the TPB elements. In addition, these findings also imply that the utility of TPB in explaining people's intention to receive vaccines appears to be contextual-specific and that there might be other factors moderating the focal relations. Hence, further investigation of the boundary conditions may improve the explanatory utility of TPB in understanding people's intention to receive vaccines.

This study was among the first to reveal gender differences in the associations between TPB elements and people's intention to receive vaccines. Specifically, attitudes were only related to males', while subjective norms were only related to females', intention. This finding may be explained from the lens of the agency vs. communion perspectives which have been used to explain the associations between gender and health-related behavior.^{24–27} According to Helgeson,²⁸ men and women are socialized to adopt different behavior patterns and social roles, with men being more likely to develop personality traits and behaviors related to agency (i.e., a focus on the self and autonomy) whereas women being more likely to develop personality traits and behaviors related to communion (i.e., a focus on other people and relationships). Based on these views, we speculate that males (vs. females) are more assertive and reliant on their own judgments to decide whether to receive vaccines; by contrast, females (vs. males) decide whether to receive vaccines depending on the thoughts and behavior of the people around them. These gender-specific associations suggest different tactics should be employed to promote males' and females' intention to receive vaccines.

The present findings have several implications on how to boost people's vaccination intention. First, enhancing one's perceived behavioral control would be an important approach to boost both

males' and females' intention. In this regard, reducing the barriers (e.g., complicated procedure, high cost) and promoting the facilitatory factors (e.g., enhancing the convenience for people to receive vaccines) might be helpful. Second, promoting males' positive attitudes toward the vaccines is another crucial way to enhance their intention, such as providing them with more positive information or framing the information in a positive manner to help them evaluate the vaccines more positively. Third, involving significant others to receive vaccines may be an important strategy to promote female's intention, such as encouraging female's relatives and/or friends to receive vaccines with them.

Limitations

We must acknowledge that the current study has several limitations. First, the current sample was only recruited from China and student sample was over-represented, which might limit the generalizability of the findings to other age groups and people from other countries. As mentioned above, peoples' intention to receive vaccines and its associations with TPB elements may be contextual-specific, and thus further investigation in other countries and with more representative samples is highly needed. Second, the cross-sectional design limits causal inference and the use of self-reported data might inflate the associations, although prior studies that examined this issue adopted similar methodologies.^{17–19–21} Third, we only examined people's intention but did not consider their actual behavior. Given the gap between intention and behavior,¹⁶ it would be necessary and promising to examine this issue in future studies. Ideally, it would be important to examine the extent to which vaccination intention would predict the actual behavior of receiving vaccines. Despite these drawbacks, the present study advances our understanding of Chinese people's intention to receive vaccines and the moderation of gender in the context of vaccination campaign, informing nuanced ways to boost males' and female's vaccination intention. We consider that the current findings are valuable, not only because the vaccination rate worldwide was still not satisfactory when this study was being conducted but also because it prompts scholars and practitioners to get better preparation for similar medical pandemics that may come in the future.

Conclusions

Chinese people's intention to receive vaccines against COVID-19 is moderate after the vaccines are available. In general, people with strong subjective norms and perceived behavioral control have stronger intention to receive vaccines. Moreover, attitudes are only related to males' intention while subjective norms are only related to females' intention. Such nuanced gender differences suggest the importance of considering the moderation effect of gender in future studies. These differences also inform gender-specific strategies to boost males' and females' intention to receive COVID-19 vaccines.

Disclosure statement

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