

BMJ Open How can the uptake of preventive behaviour during the COVID-19 outbreak be improved? An online survey of 4827 Chinese residents

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ABSTRACT

Objectives The aims of this study were to assess the uptake of preventive behaviour during the COVID-19 outbreak and to investigate the factors influencing the uptake of preventive behaviour based on the theory of planned behaviour (TPB).

Design, setting and participants A cross-sectional online survey was conducted among Chinese residents aged ≥ 18 years and 4827 participants from 31 provinces and autonomous regions were included in the current study. Uptake of preventive behaviour, attitude towards the spread of COVID-19 and preventive behaviour, subjective norms, perceived behavioural control, demographic characteristics and the information attention and processing mode were measured. Multivariate logistic regressions were used to identify associations between the potential influencing factors and uptake of preventive behaviour.

Results There were 2393 (52.8%) respondents reported high uptake of preventive behaviour. Multivariate analyses demonstrated that attitude towards the behaviour, subjective norms and perceived behavioural control were significantly correlated with uptake of preventive behaviour, and perceived behavioural control was the strongest influencing factor (OR=4.09, 95% CI 3.57 to 4.69). Furthermore, systematic information processing mode was positively associated with high uptake of preventive behaviour compared with heuristic information processing mode (OR=2.16, 95% CI 1.67 to 2.81).

Conclusions These findings are helpful for developing education and interventions to promote high uptake of preventive behaviour and enhance public health outcomes during pandemic.

INTRODUCTION

The WHO declared the COVID-19 outbreak a pandemic on 11 March 2020. By 10 June 2020, 7 805 148 confirmed cases of COVID-19 and 431 192 deaths had been reported globally.¹ In the absence of a vaccine to prevent COVID-19, the best way to prevent illness is to avoid being exposed to the virus. Early in the outbreak of COVID-19, the Chinese government, the Chinese Center for Disease

Strengths and limitations of this study

- We referred to the item in the theory of planned behaviour (TPB) to choose the potentially influencing factors of the uptake of preventive behaviour and explore the predictor of uptake of preventive behaviour during COVID-19.
- Information attention and systematic information processing mode regarding pandemic were helpful for promoting high uptake of preventive behaviour, which may provide references for epidemic control in other countries.
- Online survey was used for rapid assessment, which may lead to selection bias.
- The survey was completed in the relatively short-time period, so the results may not reflect the long-term practice of preventive measures.
- The measurement accuracy heavily depends on respondents' ability or willingness to recall their behaviours, which may be underreported or overreported.

Control and Prevention (CDC), and local health departments implemented measures to control the transmission of COVID-19, including isolation and quarantine, contact tracing of persons with COVID-19 and community containment. These aggressive measures appear to be successful in reducing the number of deaths and hospitalisations^{2,3} and could keep the disease at a level that does not exceed the capacity of the healthcare system.⁴

Additionally, measures related to improved personal hygiene were widely publicised in the media as a way to prevent infection. An improved understanding of the drivers of refusal to engage in nonpharmaceutical interventions may help tailor messaging and increase the chances of eliciting behavioural change.⁵ Several studies have reported that transmission may occur early in the course of infection⁶ and that persons who show no

signs or symptoms of respiratory infection nevertheless shed SARS-CoV-2, the virus that causes COVID-19.^{2 3} In addition, the communicable period, defined as the interval from the first day of positive nucleic acid tests to the first day of continuous negative tests, can be up to 3 weeks, and patients in this communicable period could develop severe illness.⁷ Under such circumstances, several institutions, including the WHO, the Chinese CDC and the US CDC, recommend that the general public take preventive actions to prevent the spread of respiratory diseases, such as avoiding travel to high-risk areas and contact with individuals who are symptomatic, washing hands frequently with soap and water and wearing a mask if going out.^{8–10} In China, considering that China's population density is much higher than that in most other countries, which increases the likelihood of virus transmission, the Chinese CDC and National Health Commission of the People's Republic of China additionally recommended wearing masks when out in public, decreasing communication and avoiding nonessential excursions.¹¹ All these findings and official recommendations indicate that individual behaviour is essential in controlling the pandemic. Hence, it is important to investigate the factors influencing people's uptake of preventive behaviour to minimise the spread of COVID-19. The theory of planned behaviour (TPB), which has been widely applied to explain many types of behaviours,^{12 13} suggests that one's intention is the most important predictor leading to behaviour and is determined by three direct factors: attitude towards the behaviour (a favourable or unfavourable evaluation of the particular behaviour), subjective norms (perceived social pressure to perform or not perform the behaviour) and perceived behavioural control (the perception of self-efficacy with respect to the ability to perform the behaviour).^{12 14 15} Previous studies based on the TPB have demonstrated that attitude towards the behaviour, subjective norms and perceived behavioural control have a significant positive influence on self-isolation during a pandemic emergency.¹⁶ Furthermore, the TPB model was reported to explain 51.7% ($p < .001$) of the variance in A/H1N1 vaccine intentions,¹⁷ and the extended TPB could predict 60% of adults' intention to receive the swine flu vaccine.¹⁸ In addition, several other factors may affect the uptake of preventive behaviour. The information processing mode can interact with social media to influence people's perception formation¹⁹ and then affect behaviour; sociodemographic characteristics such as gender^{20–22} and education²³ were also reported to affect attitudes and behaviours related to pandemics.

To date, few studies in the health context have investigated the factors influencing uptake of preventive behaviour during the COVID-19 outbreak. Considering the global spread of COVID-19, we aim to investigate the factors related to uptake of preventive behaviour referring to the items in TPB to identify ways to promote the uptake of preventive behaviour among the public and provide a reference for epidemic control in other countries.

METHOD

Design and participants

This cross-sectional online survey was conducted through the Wenjuanxing platform (<https://www.wjx.cn/app/survey.aspx>) from 31 January to 2 February 2020. The survey took approximately 10 min to complete, and an item with required answer was established to avoid the return of invalid questionnaires. Chinese residents aged ≥ 18 years were invited through social media to participate in the survey. Since this online survey was disseminated via website and WeChat, the number of people who were reached could not be acquired. In total, 5851 surveys were returned. After information sorting and cleaning, we removed the invalid questionnaires, including those spent less than 5 min completing the questionnaires, which are based on the entire large questionnaire included 97 items designed by our research team, and those failed to answer the quality control questions. Finally, 4827 participants from 31 provinces and autonomous regions were included in the current study.

Patient and public involvement statement

Some participants were invited to help design the questionnaires and attend the pilot survey separately, but they were not involved in the recruitment, conduct, reporting or dissemination plans. The results of the survey have already been disseminated to all participants via website and WeChat, especially behavioural advice for prevention of COVID-19.

Selection of factors related to uptake of preventive behaviour and measurements

Uptake of preventive behaviour: as a dependent variable, the degree of uptake of preventive behaviour was included in the study to measure if people uptake the personal precaution against COVID-19. Scales ranging from 1=I strongly disagree to 5=I strongly agree measured people's recent uptake of preventive measures captured in these four statements: (1) 'since the outbreak of COVID-19, I have been wearing a mask in public', (2) 'since the outbreak of COVID-19, I have washed my hands more frequently and thoroughly with soap and water', (3) 'since the outbreak of COVID-19, I have avoided nonessential conversation and personal contact with others' and (4) 'since the outbreak of COVID-19, I have avoided nonessential going out or taking public transportation'. Because all the four items were referred to the guidelines published by China CDC and WHO and were all important and basic individual behaviours to prevent COVID-19, therefore, in this study, only participants who chose 5 (strongly agree) for all four questions were defined as having high uptake of preventive behaviour.

We explored the factors related to uptake of preventive behaviour referring to the items in TPB. In addition, the resources and opportunities available to a person, such as the availability of masks, to some extent dictate the likelihood of intended and actual behaviour.²⁴ Moreover, we added other potential influencing factors. As shown in

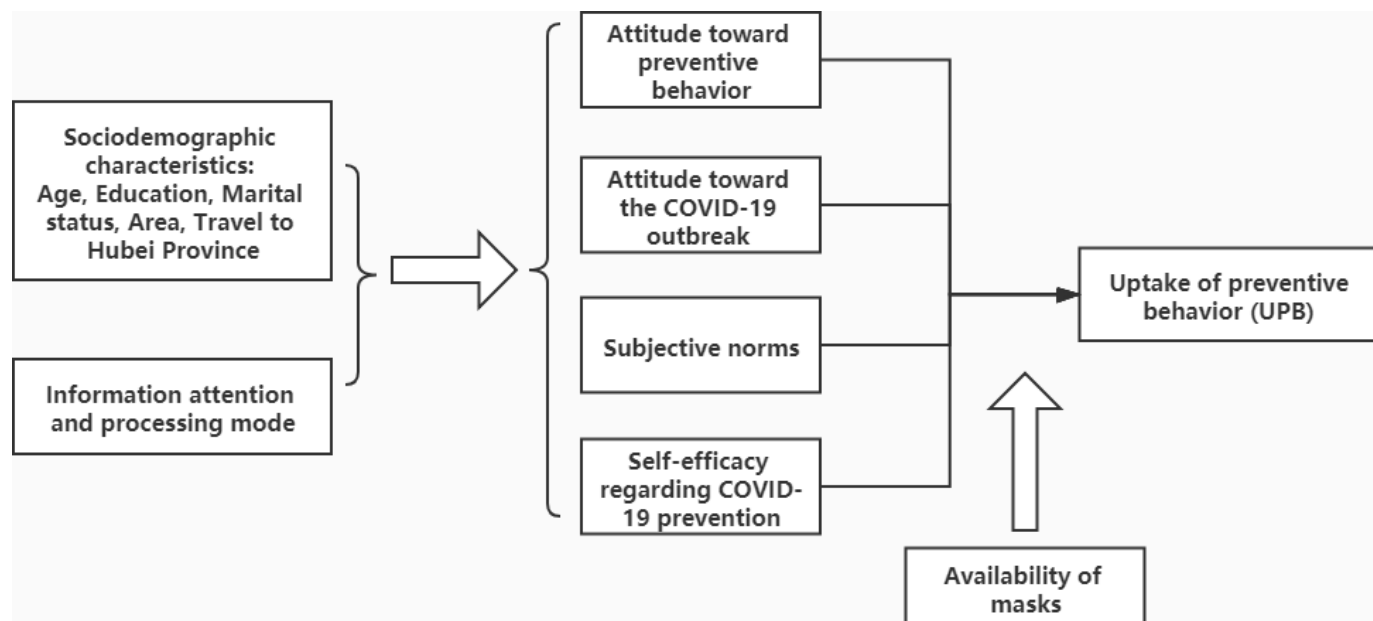


Figure 1 Application of the theory of planned behaviour to investigate predictors of uptake of protective behaviours in the context of COVID-19 pandemic.

figure 1, we added ‘attitude towards COVID-19 outbreak’ to the attitude towards the behaviour section because it could directly influence the attitude towards preventive behaviour.^{25 26} Subjective norms were measured using the perception about the public preventive action, which directly bring the social pressure. Three questions related to self-efficacy were used to assess perceived behavioural control.²⁷

Uptake of preventive behaviour, attitude towards the behaviour, subjective norms, perceived behavioural control and the information attention and processing mode were measured by questionnaires. The detailed information of survey questions, variable description and processing were shown in table 1.

Statistical analyses

The X^2 test was applied to determine the prevalence of the uptake of preventive behaviour by the categorical variables, including demographic characteristics, attitude towards the behaviour, subjective norms, perceived behavioural control, degree of attention to COVID-19 and the information processing mode. The underlying structure of the items and their factor loadings were identified by using the exploratory factor analysis (EFA); the extraction was made using the principal components and the rotation using the Varimax method. Multivariate logistic regression analyses were applied to assess the association between the potential influencing factors and the uptake of preventive behaviour after controlling for related characteristic covariates. Adjusted ORs and their 95% CIs were used to quantify the effects. The sensitivity, specificity and the area under the receiver operating characteristic (ROC) curve were calculated to evaluate the logistic regression model. SPSS software V.22.0 (SPSS, Chicago, Illinois, USA) was used to carry out all analyses.

All tests were two sided, and $p < 0.05$ was considered statistically significant.

RESULTS

Descriptive statistics

Among the 5851 questionnaires returned, 4827 (82.5%) were valid, reflecting a completion rate of 83.27%. We additionally excluded 294 participants who could not buy masks. Ultimately, 4533 participants were included in the analysis. Table 2 provides descriptive statistics for the characteristics of the respondents. Overall, the mean age of the respondents was 32.45 ± 9.971 years (range 18–85, IQR=13), and almost half of the respondents were between the ages of 21 and 30. Of the participants, 68.1% were women. The majority of the respondents (62.1%) had a bachelor’s degree or a college education. More than half of respondents (55.0%) were married. Only 5.3% were medical staff and 2.7% had a history of travel to Hubei Province (the high risk areas of COVID-19 outbreak). Approximately 82.0% lived in urban areas and 18.0% reported that someone in their community was suspected or confirmed to have COVID-19.

Regarding preventive behaviour, 75.1% of the respondents reported that they wore masks when going outside, 66.1% washed their hands frequently, 66.0% avoiding talking to or touching others and 73.0% avoided unnecessary use of public transportation. Overall, 52.8% of participants reported high uptake of preventive behaviour. As shown in table 2, the proportion of high uptake of preventive behaviour among men (51.0%) was lower than that among women (53.6%). The uptake of preventive behaviour

Table 1 Description of the variables

Variable	Indicators	Variable description	Variable processing	Mean±SD
Independent variable	Uptake of preventive behaviour	<p>(1) Since the outbreak of COVID-19, I have been wearing a mask in public.</p> <p>(2) Since the outbreak of COVID-19, I have washed my hands more frequently and thoroughly with soap and water.</p> <p>(3) Since the outbreak of COVID-19, I have avoided nonessential conversation and personal contact with others.</p> <p>(4) Since the outbreak of COVID-19, I have avoided nonessential excursions and public transportation.</p>	Obtain the degree of agreement. Participants who chose 5 (strongly agree) for all four questions were defined as having high uptake of preventive behaviour.	4.64±0.505
Attitude towards the behaviour	Attitude towards preventive behaviour	<p>(1) The virus mainly infects the elderly, and young people need not be concerned about it.</p> <p>(2) If you do not eat wild animals or seafood, you will not be infected with COVID-19.</p> <p>(3) You must wash your hands when you come in from outside.</p> <p>(4) It is important to eat a balanced diet and maintain a positive mood to prevent infection.</p>	1=agree; 0=disagree;	0.87±0.334
Attitude towards COVID-19	How great do you perceive the overall risk of the COVID-19 pandemic to be?	How great do you perceive the risk of infection?	<p>1=No risk at all; 2=Low risk;</p> <p>3=General risk; 4=Relatively high risk;</p> <p>5=Very high risk;</p>	4.51±0.647
Subjective norms	Subjective norms	The proportion of others wearing masks in public places.	High=Very high/Relatively high; Moderate=General; Low=Low/None	3.00±1.268
Perceived behavioural control	Self-efficacy regarding COVID-19 prevention	<p>(1) I can avoid COVID-19 infection.</p> <p>(2) I know how to avoid COVID-19.</p>	1=No one; 2=Less than half; 3=Half; 4=Most; 5=All;	4.20±0.719
Information attention and processing mode	Heuristic-systematic processing (HSM)	<p>Heuristic information processing (HIP)</p> <p>(1) I am able to make decisions about COVID-19 based on my existing knowledge without seeking additional information.</p> <p>(2) I can make a fully informed decision about COVID-19 based on my previous experience.</p> <p>Systematic information processing (SIP)</p> <p>(1) When I encounter information about COVID-19, I make an effort to carefully analyse it.</p> <p>(2) When I encounter information about COVID-19, I am likely to stop and think about it.</p>	<p>1=Strongly disagree; 2=Disagree;</p> <p>3=Neutral; 4=Agree; 5=Strongly agree;</p> <p>The median of respondents' averaged index (median=0.0) was used for binary categorical classification (high/low level).</p> <p>By comparing the means of the two corresponding items, information processing was classified as HIP (HIP score>SIP score), HS-equivalent (HIP score=SIP score), or SIP (SIP score>HIP score).</p>	4.20±0.643
Degree of attention to COVID-19	Degree of attention to COVID-19	In the past month, how much time did you spend focused on COVID-19 information every day?	1=None; 2=Less than an hour; 3=1–3 hours; 4=3–5 hours; 5=More than 5 hours;	3.34±1.038

Table 2 Participants' characteristics and uptake of preventive behaviour

	Total N (%)	Low uptake of preventive behaviour N (%)	High uptake of preventive behaviour N (%)	χ^2	P
Gender				2.752	0.097
Male	1444 (31.9)	708 (49.0)	736 (51.0)		
Female	3089 (68.1)	1433 (46.4)	1656 (53.6)		
Age (years)				30.255	<0.001
<20	234 (5.2)	140 (59.8)	94 (40.2)		
21–30	2145 (47.3)	1058 (49.3)	1087 (50.7)		
31–40	1236 (27.3)	538 (43.5)	698 (56.5)		
41–50	705 (15.6)	304 (43.1)	401 (56.9)		
>51	213 (4.7)	101 (47.4)	112 (52.6)		
Education				31.925	<0.001
Middle school	240 (5.3)	113 (47.1)	127 (52.9)		
High School	742 (16.4)	301 (40.6)	441 (59.4)		
College	2817 (62.1)	1322 (46.9)	1495 (53.1)		
Master's degree	734 (16.2)	405 (55.2)	329 (44.8)		
Marital status				55.88	<0.001
Married	2492 (55.0)	1052 (42.2)	1440 (57.8)		
Not married	2041 (45.0)	1089 (53.4)	952 (46.6)		
Occupation				0.014	0.906
Healthcare worker	239 (5.3)	112 (46.9)	127 (53.1)		
Other	4294 (94.7)	2029 (47.3)	2265 (52.7)		
Province				0.982	0.322
Hubei	124 (2.7)	64 (51.6)	60 (48.4)		
Other	4409 (97.3)	2077 (47.1)	2332 (52.9)		
Area				10.87	0.001
Urban	3719 (82.0)	1714 (46.1)	2005 (53.9)		
Rural	814 (18.0)	427 (52.5)	387 (47.5)		
Community COVID-19 epidemic				4.844	0.184
No COVID-19 cases	3488 (76.9)	1626 (46.6)	1862 (53.4)		
Under medical observation	376 (8.3)	191 (50.8)	185 (49.2)		
Suspected case	242 (5.3)	126 (52.1)	116 (57.9)		
Confirmed case	427 (9.4)	198 (46.4)	229 (53.6)		
Travel to Hubei				7.861	0.005
No	4176 (92.1)	1947 (46.6)	2229 (53.4)		
Yes	357 (7.9)	194 (54.3)	163 (45.7)		
Self-rate health					
Poor	254 (11.9)	208 (8.7)	462 (10.2)	12.387	<0.001
Good	1887 (88.1)	2184 (91.3)	4071 (89.8)		

was also influenced by age, with those 31–50 years old accounting for the highest proportion of high uptake of preventive behaviour and those younger than 20 accounting for the lowest proportion of high uptake of preventive behaviour. Education was also an influencing factor, with the highest proportion of high uptake of preventive behaviour observed among respondents with a high school education and the

lowest proportion among respondents with a master's degree. Respondents from urban areas reported a significantly higher proportion of high uptake of preventive behaviour than those from rural areas (53.9% vs 47.5%). Respondents who had a history of travel to Hubei Province (53.4%) reported a higher proportion of high uptake of preventive behaviour than others (45.7%).

Table 3 The results of factor analysis referring to the items in TPB

Indicators	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
How great do you perceive the overall risk of the COVID-19 pandemic to be?	0.029	0.045	-0.146	-0.041	0.026	0.882
How great do you perceive the risk of infection?	0.071	-0.209	0.406	-0.049	0.393	0.446
The proportion of others wearing masks in public places.	-0.048	-0.065	-0.083	-0.034	0.801	0.120
I am able to make decisions about COVID-19 based on my existing knowledge without seeking additional information.	-0.092	0.931	0.122	0.087	-0.048	0.002
I can make a fully informed decision about COVID-19 based on my previous experience.	-0.074	0.926	0.152	0.110	-0.059	-0.008
When I encounter information about COVID-19, I make an effort to carefully analyse it.	0.016	0.136	0.108	0.887	0.003	-0.005
When I encounter information about COVID-19, I am likely to stop and think about it.	-0.006	0.050	0.155	0.885	-0.050	-0.057
The virus mainly infects the elderly, and young people need not be concerned about it.	0.695	-0.049	-0.020	-0.001	0.278	-0.120
If you do not eat wild animals or seafood, you will not be infected with COVID-19.	0.476	0.012	-0.122	0.001	0.490	-0.185
You must wash your hands when you come in from outside.	0.798	-0.075	0.000	-0.021	-0.100	0.127
It is important to eat a balanced diet and maintain a positive mood to prevent infection.	0.810	-0.061	0.042	0.029	-0.082	0.079
I can avoid COVID-19 infection.	-0.019	0.134	0.850	0.115	-0.072	-0.025
I know how to avoid COVID-19.	-0.006	0.174	0.804	0.183	-0.080	-0.105

TPB, theory of planned behaviour.

Association of the uptake of preventive behaviour with influencing factors

Considering that potential influencing factors of uptake of preventive behaviour were designed referring to the items in TPB, EFA was first performed to examine the underlying structure of the items and their factor loadings to support and strengthen the following association analysis of the uptake of preventive behaviour with influencing factors. As shown in [table 3](#), the EFA result was in accordance with items been grouped into constructs in [table 1](#). The proportion of the variance explained by the retained factors was 72.2% and the Cronbach's alpha of all items is 0.6.

As shown in [table 4](#), multivariable logistic regression analysis was used to test the influencing factors associated with the uptake of preventive behaviour. The fully fitted model had an ROC value of 0.727 while put in all the factors of the regression. For attitude towards the behaviour, compared with those with partially positive attitudes, respondents with completely positive attitudes towards preventive behaviour (OR=1.42, 95% CI 1.16 to 1.73) or paid attention towards the risk of COVID-19 (OR=1.73, 95% CI 1.52 to 1.97) had increased adjusted odds of high uptake of preventive behaviour. Regarding subjective norms, perceptions of a higher proportion of public precaution increased the adjusted odds of high uptake of preventive behaviour (most vs half and less than half: OR=1.52, 95% CI 1.15 to 2.00, all vs half and less than half: OR=1.67, 95% CI 1.24 to 2.25, unknown vs half and less than half: OR=1.62, 95% CI

1.09 to 2.42, respectively). Perceived behavioural control was the strongest influencing factor of uptake of preventive behaviour. Respondents with high self-efficacy in preventing COVID-19 were 4.09 times more likely to have a high uptake of preventive behaviour than those with low self-efficacy (OR=4.09, 95% CI 3.57 to 4.69). Furthermore, there are also several other influencing factors of uptake of preventive behaviour. Respondents who engaged more in systematic information processing (SIP) mode were more likely to have high uptake of preventive behaviour than those engaged more in Heuristic information processing (HIP) mode and Heuristic-systematic-equivalent information processing mode (SIP vs HIP: OR=2.16, 95% CI 1.67 to 2.81, HS-equivalent vs HIP: OR=1.78, 95% CI 1.34 to 2.35). Increased attention to COVID-19 was significantly associated with increased adjusted odds of high uptake of preventive behaviour (1–3 hours vs <1 hour: OR=1.19, 95% CI 1.01 to 1.41 and >3 hours vs <1 hour: OR=1.39, 95% CI 1.18 to 1.65). Additionally, married and urban respondents had higher uptake of preventive behaviour than those who were not married (OR=1.25, 95% CI 1.05 to 1.49).

We also compared the characteristics of the respondents reporting that they could obtain masks and those reporting that they could not ([table 5](#)). The results indicated that respondents who were men (OR=1.39, 95% CI 1.09 to 1.78), not married (OR=1.90, 95% CI 1.49 to 2.42) or from a rural area (OR=2.11, 95% CI 1.64 to 2.73) were more likely to report that masks were not available.

Table 4 Logistic regression of uptake of preventive behaviour

Variables	B	SE	Wald	P	OR	95% CI	
						Lower	Upper
External personality factors							
Gender							
Male					1.000		
Female	0.175	0.071	6.174	0.013	1.192	1.038	1.368
Age(years)							
-20			4.397	0.355	1.000		
21-30	0.265	0.154	2.975	0.085	1.304	0.965	1.762
31-40	0.148	0.175	0.720	0.396	1.160	0.823	1.634
41-50	0.219	0.186	1.381	0.240	1.245	0.864	1.794
51-	0.143	0.226	0.400	0.527	1.153	0.741	1.795
Education							
Middle school			5.479	0.140	1.000		
High School	0.143	0.166	0.744	0.389	1.153	0.834	1.595
College	0.034	0.156	0.046	0.829	1.034	0.762	1.404
Master	-0.136	0.174	0.612	0.434	0.873	0.620	1.228
Marriage							
No married					1.000		
Married	0.221	0.089	6.147	0.013	1.247	1.047	1.486
Occupation							
Other					1.000		
Healthcare worker	0.131	0.146	0.805	0.370	1.140	0.856	1.519
Province							
Other					1.000		
Hubei	0.134	0.236	0.322	0.570	1.143	0.720	1.816
Area							
Rural					1.000		
Urban	0.170	0.091	3.511	0.061	1.186	0.992	1.417
Community COVID-19 epidemic							
No COVID-19 cases			2.625	0.453	1.000		
Under medical observation	-0.151	0.119	1.599	0.206	0.860	0.681	1.086
Suspected case	-0.158	0.147	1.152	0.283	0.854	0.640	1.139
Confirmed case	0.008	0.113	0.005	0.942	1.008	0.808	1.258
Travel to Hubei							
No					1.000		
Yes	0.201	0.146	1.905	0.168	1.222	0.919	1.626
Self-rate health							
Poor					1.000		
Good	0.099	0.108	0.845	0.358	1.105	0.893	1.365
Information-processing							
Heuristic processing			35.270	<0.001	1.000		
Heuristic-systematic-equivalent processing	0.574	0.142	16.304	<0.001	1.776	1.344	2.346
Systematic processing	0.772	0.133	33.544	<0.001	2.164	1.666	2.809
Attention on COVID-19							
<1 hour			14.925	0.001	1.000		
1-3 hour	0.177	0.086	4.217	0.040	1.194	1.008	1.414
>3 hour	0.332	0.087	14.694	<0.001	1.394	1.176	1.652

Continued

Table 4 Continued

	Variables	B	SE	Wald	P	OR	95% CI	
							Lower	Upper
Attitude towards the behaviour	Risk perception of COVID-19							
	Low					1.000		
	High	0.547	0.067	66.614	<0.001	1.729	1.516	1.972
	Perceived risk of self-infection							
	Low			0.085	0.959	1.000		
	Moderate	0.012	0.079	0.024	0.877	1.012	0.866	1.183
	High	0.024	0.083	0.084	0.772	1.024	0.871	1.204
	Attitude toward preventive behaviour							
	Completely positive attitude					1.000		
Partially positive attitude	0.349	0.103	11.584	0.001	1.418	1.160	1.733	
Subjective norms	Other people wearing marks in public places							
	Half and less than half			11.475	0.009	1.000		
	Most	0.417	0.142	8.655	0.003	1.517	1.149	2.003
	All	0.510	0.153	11.197	0.001	1.666	1.235	2.246
	Unknown	0.485	0.204	5.639	0.018	1.624	1.088	2.424
Perceived behavioural control	Self-efficacy							
	Low					1.000		
	High	1.408	0.070	407.497	<0.001	4.090	3.567	4.689
Constant		-3.281	0.338	94.066	<0.001	0.038		

All the variables shown in table 4 included in a single model.

DISCUSSION

In the present study, we demonstrate that 52.8% of participants reported high uptake of preventive behaviour, with full compliance with wearing masks in public, frequent hand washing, avoidance of talking to or touching others and avoidance of unnecessary public transportation use. We explored the potential factors influencing the uptake of preventive behaviour during a pandemic referring to the items in TPB. The results show that attitude towards the behaviour, subjective norms and perceived behavioural control have significant influences on uptake of preventive behaviour. Information processing mode, attention to the pandemic and several sociodemographic characteristics also influenced high uptake of preventive behaviour.

The results showed that attitude towards the behaviour, subjective norms and perceived behavioural control have significant positive influences on the uptake of preventive behaviour in the context of COVID-19, which was consistent with a previous study that reported the positive influence of attitude towards the behaviour, subjective norms and perceived behavioural control on self-isolation during the pandemic.¹⁴ Of these three considered factors, perceived behavioural control (self-efficacy with respect to preventing COVID-19) was the strongest predictor. Respondents with high self-efficacy regarding preventing COVID-19 were 3.6 times more likely to have high uptake

of preventive behaviour than those with low self-efficacy. This result supports previous studies indicating that self-efficacy will result in protection motivation leading to changes in attitudes, perceptions or behaviours.²⁸ For attitude towards the behaviour, compared with a partially positive attitude, a completely positive attitude towards preventive behaviour or paid attention towards the risk of COVID-19 was significantly associated with high uptake of preventive behaviour; however, the degree of agreement with the likelihood of self-infection was not associated with high uptake of preventive behaviour in a multivariable analysis. Consistent with our findings, Kim also reported that the perceived likelihood of getting sick (cognitive element) was not strongly associated with preventive behaviours, whereas perceived concern (emotional element) was significantly associated with precautionary and preparatory behaviours.²⁹ One possible reason is that the population is generally susceptible due to the highly contagious nature of the virus³⁰; therefore, people's judgements of the severity of the pandemic better reflect their awareness and precautions.

It is worth noting that the information processing mode was a pivotal factor influencing the uptake of preventive behaviour during the COVID-19 outbreak. Respondents who engaged more in SIP were two times as likely to intend to take a high level of preventive behaviour against COVID-19 than those who engaged in HIP. SIP

Table 5 Characteristics of respondents reporting the availability or unavailability of masks

	Total (n=4649)	Masks are available (n=4533)	Masks are not available (n=294)	χ^2	P
Gender				7.292	0.007
Male	1560 (32.3)	1444 (92.6)	116 (7.4)		
Female	3267 (67.7)	3089 (94.6)	178 (5.4)		
Age (years)				19.154	0.001
<20	256 (5.3)	234 (91.4)	22 (8.6)		
21–30	2312 (47.9)	2145 (92.8)	167 (7.2)		
31–40	1288 (26.7)	1236 (96.0)	52 (4.0)		
41–50	749 (15.5)	705 (94.1)	44 (5.9)		
>51	222 (4.6)	213 (95.9)	9 (4.1)		
Education				1.832	0.608
Middle school	257 (5.3)	240 (93.4)	17 (6.6)		
High School	782 (16.2)	742 (94.9)	40 (5.1)		
College	3002 (62.2)	2817 (93.8)	185 (6.2)		
Master's degree	786 (16.3)	734 (93.4)	52 (6.6)		
Marital status				27.955	<0.001
Married	2607 (54.0)	2492 (95.5)	115 (4.4)		
Not married	2220 (46.0)	2041 (91.9)	179 (8.1)		
Occupation				0.794	0.373
Healthcare worker	251 (5.2)	239 (95.2)	12 (4.8)		
Other	4576 (94.5)	4294 (93.8)	282 (6.2)		
Province				0.508	0.476
Hubei	130 (2.7)	124 (95.4)	6 (4.6)		
Other	4697 (97.3)	4409 (93.9)	288 (6.1)		
Area				33.838	<0.001
Urban	3920 (81.25)	3719 (94.9)	201 (5.1)		
Rural	907 (18.8)	814 (89.7)	93 (10.3)		
Community COVID-19 epidemic				1.822	0.610
No COVID-19 cases	3707 (76.80)	3488 (94.1)	219 (5.9)		
Under medical observation	404 (8.37)	376 (93.1)	28 (6.9)		
Suspected case	262 (5.43)	242 (92.4)	20 (7.6)		
Confirmed case	454 (9.41)	427 (94.1)	27 (5.9)		

requires greater attention to acquiring information,³¹ so people engaged more in SIP will have greater risk awareness due to the evaluation of information and then uptake of preventive actions; however, this result should be interpreted in a specific context or situation, such as the COVID-19 pandemic, as people were unfamiliar and uninformed regarding the infectious disease. As Trumbo mentioned, the notion that only rational and systematic judgement can lead to suitable actions, avoidance of inadequate actions or unnecessary overreactions to risk needs to be re-examined.³² Additionally, information processing is an important component of health literacy, which can be understood as the capacity of individuals to obtain, process, and understand basic health information to make decisions to maintain health and improve quality

of life.³³ Hence, it may be an effective way to improve the health literacy and in turn uptake of preventive behaviour regarding the pandemic through educating the public to evaluate and analyse information (SIP mode) of pandemic.

The sociodemographic characteristic factors should also be given more attention. Our findings suggested that people living in rural areas have a lower proportion of high uptake of preventive behaviour than those living in urban areas, which may be due to poorer health literacy related to infectious diseases in rural areas than in urban areas.³⁴ Low literacy relates to less knowledge about health, which leads to decreased adherence to positive health behaviours.^{35 36} Furthermore, marital status is an important social factor associated with human health and



longevity.^{37–40} The marriage protection effect refers to the fact that married people have more advantages related to family support, including psychological support and health behaviour support. Our results support the protective role of marriage in the uptake of preventive behaviour during the pandemic. All these findings indicated that people living in rural areas and people who are not married should be given more attention in terms of health education and health promotion, and their social, psychological and physiological characteristics should be taken into account. In addition, the issue of mask availability among those who are men, over 31 years old, not married or from rural areas, should be taken into account because, in this survey, these people reported that masks were not available.

The results of this study should be considered in the light of the following limitations. First, an online survey was used for rapid assessment, which may have resulted in selection bias. For example, some older people with low education levels or serious chronic diseases may not be included in the survey, and more comprehensive investigations are needed. Second, this study relied on cross-sectional survey data to examine the relationships. Therefore, the results of the analyses should be interpreted with care because causal relationships between variables may exist. Third, the survey was completed in the relatively short time period, so the results may not reflect the long-term practice of preventive measures after the survey. Fourth, although self-report measures are very convenient and common in some fields of media research,⁴¹ the measurement accuracy heavily depends on respondents' ability or willingness to recall their behaviours, which may be underreported or overreported. Fifth, although our findings indicated the potential way of referring to the TPB theory to explore influencing factors of uptake of preventive behaviour in the early stage of COVID-19, the theoretical application is insufficient, which needs the further research with the modelling approach in the future study. Finally, our survey was based on social media, which may skew younger, educated and urban people, in turn may affect the generalisability.

CONCLUSION

Despite the cited limitations, our results are helpful for developing education and interventions to support health behaviours and enhance outcomes in the public during a pandemic emergency. Attitude towards the behaviour, subjective norms and perceived behavioural control has significant positive influences on the uptake of preventive behaviour during a pandemic, with perceived behavioural control (self-efficacy) playing the most important role. Therefore, developing education programmes focused on improving awareness of SIP and attention to the pandemic are helpful in promoting high uptake of preventive behaviour during pandemics.

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