

# Estimating the direct and indirect effects of trust and perceptions of SARS-CoV-2 infection risk on COVID-19 re-vaccination willingness in a Singapore cohort

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## Background

As SARS-CoV-2 has become endemic, countries have delisted COVID-19 vaccinations as a mandatory vaccination including Singapore. While current threat of the re-emergence of SARS-CoV-2 is low in Singapore, the probability for clusters to re-emerge is not zero. The primary vaccination series for COVID-19 saw high uptake in the Singapore population once it became available, with 88% having received the full regimen<sup>1</sup>. Vaccinations were critical in mitigating transmission and reducing the risk of developing severe disease and death. However, as the virus evolved and updated booster vaccinations were required for vaccines to confer protection to the mutated strains, vaccine uptake was worrying low with only 15% of those aged 60 years and above having taken more than four doses<sup>2</sup>. Using the SOCRATES cohort<sup>3</sup>, a survey was conducted in October 2023 to understand the factors that influenced vaccine willingness towards the COVID-19 boosters.

## Methods

- Design: Repeated surveys on participants' knowledge, attitudes, opinions and perceptions on risks posed by infectious diseases and interventions to control such outbreaks in Singapore.
- Eligibility: SCs or PRs, ≥16 years, residing in Singapore, with internet-enabled device access, willingness to complete digital surveys.
- Recruitment: Snowball sampling, door-to-door invitations, and community outreach.
- Data collection: From 11 to 18 Oct 2023, 1,304 Singapore Citizens (SCs) and Permanent Residents (PRs) were surveyed on their COVID-19 infection history, vaccination experience, trust in institutions, risk perceptions, and information seeking behaviours. The survey was designed used a combination of Protection Motivation Theory (PMT) and Health Belief Model (HBM) which was also used to build the groupings for the independent variables and mediator analysis.
- Analysis:
  - To obtain the effects the independent variables and mediators have on the dependent variable, ordinal logistic regression (OLS) was used to obtain the total values. Cronbach alpha was then applied to the mediator groups to determine the optimal combination of variables to be included. Once total effects and mediator groups were determined, structural equation modelling (SEM) was used to analyse if and the extent to which the independent variable were operating directly with booster willingness or indirectly through the mediators.

## Results

- In terms of demographics, sex and employment were found to have both direct and indirect effects on willingness to vaccinate.
- The ratios of indirect to total effects for sex and ethnicity (0.63 and 0.91 respectively) suggests that the effect these variables had on booster willingness are influenced by a significant proportion via mediators.
- Information sources were not found to have direct effects on vaccine willingness, operating primarily through indirect effects. Indirect effects were observed for almost all information source variables except for international news sources.
- For the mediators, *vaccine preferences, experiences and COVID-19 history* were primarily observed via indirect effects apart from history of infection (vs never infected). Other (vs community/ outpatient sites) and severe side effects from last vaccine (vs none/mild) had significantly high ratios of indirect to total effects of 0.90 and 0.88 respectively.
- This indicates that these variables principally operate through mediators.
- Perceived severity, perceived vulnerability, subjective norm, response efficacy and self-efficacy were found to have a positive direct effect on booster vaccine willingness. Only response costs had a negative effect.

Table 1. Demographics of SOCRATES cohort

Demographics	No.	%
Gender		
Male	535	41%
Female	769	59%
Age, years		
17 - 29	145	11%
30 - 59	780	60%
60 and above	379	29%
Ethnicity		
Chinese	1183	91%
Non Chinese	121	9%
Education		
'O' / 'N' level & below	351	27%
'A' / level / Polytechnic diploma	170	13%
Univeisty / Post-graduate	783	60%
Housing Type		
Publicly owned flat with ≤ 3 rooms	183	14%
Publicly owned flat with 4 - 5 rooms	732	56%
Privately owned property	389	30%
Income Category <sup>1</sup>		
Below \$5,000	417	32%
\$5,000 - \$8,999	337	26%
\$9,000 and above	548	42%
Employment status		
Employed	788	60%
Student	78	6%
Self-employed	143	11%
Not working	295	22%
Preferred language		
English	1286	98%
Chinese	22	2%
Preexisting conditions		
Diabetes	64	5%
Hypertension	139	11%
Asthma	39	3%

NOTE:

<sup>1</sup> Socrates data excludes 2 individuals who did not disclose income.

Table 2. Coefficients for mediation effects

Participant characteristics and responses	Severity	Vulnerability	Subjective norm	Response Efficacy	Self Efficacy	Response Cost
Male (vs female)		0.101 (0.051)**	0.243 (0.054)****	0.217 (0.048)****	0.086 (0.042)**	
30 to 59 yrs (vs 17-29)				-0.152 (0.076)**	-0.13 (0.067)*	
≥60 yrs (vs 17-29)	-0.051 (0.03)*	-0.156 (0.028)****		-0.078 (0.042)*	-0.12 (0.037)***	
Non Chinese (vs Chinese)			0.353 (0.091)****			-0.154 (0.078)**
Middle (vs lowest education)	-0.227 (0.087)***	-0.137 (0.056)**				
Highest (vs lowest education)	-0.117 (0.041)***		-0.052 (0.028)*			-0.069 (0.025)***
4 to 5 room (vs 2-3 room HDB)		0.118 (0.051)**		-0.096 (0.047)**		
Landed/Private (vs 2-3 room HDB)						
\$5000-\$8999 (vs below \$5,000)						-0.142 (0.061)**
\$9000 and above (vs below \$5,000)		0.07 (0.026)***	0.088 (0.027)***	0.087 (0.024)****		-0.097 (0.027)****
Student (vs Employed)	-0.326 (0.111)***					-0.331 (0.098)***
Self-employed (vs Employed)			-0.085 (0.042)**	-0.085 (0.038)**		
Not working (vs Employed)						
Chinese (vs English)						
Diabetes mellitus				0.272 (0.109)**	0.168 (0.096)*	
Hypertension						
Asthma	0.361 (0.147)**					
Level of trust in information sources						
Doctor or another health care professional				0.129 (0.053)**		-0.181 (0.051)****
Official messages (e.g. Ministry of Health, Health Promotion Board)			0.21 (0.063)***	0.188 (0.068)***		-0.133 (0.058)**
Singapore news (e.g. TV, radio, newspapers, official news websites)				0.133 (0.05)***		
International news (e.g. TV, radio, newspapers, official news websites)					0.114 (0.039)***	
Family / relatives	0.256 (0.062)****		0.1 (0.052)*			
Friends / colleagues	-0.204 (0.07)***					
Other Social media (e.g. post shared on Facebook / Instagram / Twitter)			-0.111 (0.047)**	-0.07 (0.038)*		0.14 (0.036)****
Vaccine preferences, experiences and COVID-19 history						
Hospital (vs community/outpatient sites)			-0.093 (0.052)*	-0.139 (0.045)***		0.077 (0.044)*
Others (vs community / outpatient sites)+	-0.092 (0.028)***		-0.165 (0.03)****	-0.263 (0.026)****	0.067 (0.023)***	0.134 (0.026)****
Had previous infection (vs none)	-0.879 (0.096)****	0.251 (0.097)**	-0.211 (0.103)**			-0.277 (0.088)***
Severity of most recent episode	0.309 (0.031)****	0.068 (0.031)**	0.07 (0.033)**			0.078 (0.028)***
Intermediate side effects from last vaccine (vs none / mild)		0.103 (0.057)*	-0.205 (0.061)***	-0.098 (0.052)*	-0.103 (0.045)**	0.162 (0.052)***
Severe side effects from last vaccine (vs none / mild)	0.192 (0.059)***	0.15 (0.059)**	-0.191 (0.063)***	-0.178 (0.055)***		0.339 (0.054)****
Vaccine side effects in family (vs none)				-0.26 (0.1)***		0.253 (0.097)***

\* p&lt;0.10; \*\* p&lt;0.05; \*\*\*p&lt;0.01; \*\*\*\* p&lt;0.001

†without mediating variables

‡in respondents who reported at least 1 previous COVID-19 infection

## Discussion and Conclusion:

This study highlights that vaccine hesitancy and willingness during the post-pandemic age is complex when the threat of infection is relatively low. A large proportion of the effects from demographics, trust in different information sources, and past experience with infection and vaccination can be explained via mediators.

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