Predicting COVID-19 vaccine hesitancy in Hong Kong: Vaccine knowledge, risks from coronavirus, and risks and benefits of vaccination

Stephanie Jean Tsang

Department of Communication Studies, Hong Kong Baptist University, Kowloon Tong, Hong Kong

**A B S T R A C T**

**Introduction:** Hongkongers have had access to COVID-19 vaccines for about four months, but vaccination rate remains low (34.4% as of 4 July 2021). Given that vaccine uptake is vital, this study aimed to determine how vaccine-hesitant and vaccinated individuals differ. The study also examined why people choose to delay vaccination (within 1 month, within 2 months, within 3 months, 3 months or more).

**Material and Methods:** A population-based online survey (N = 1654) was conducted between 22 and 30 June 2021, a month after the Hong Kong government announced “Say no to vaccine hesitancy” on its website. All adults aged 18 years and older were eligible to take part. The survey included sociodemographic details, perceived susceptibility to infection, and perceived vaccine efficacy and risks. A series of analyses of covariance was performed to inspect differences among the groups and multiple regression analyses were done to examine factors associated with COVID-19 vaccine hesitancy.

**Results:** With a vaccine hesitancy rate of 30.3%, analyses revealed that sociodemographic factors, party identification and self-reported health status had no effects on the degrees of vaccine hesitancy. While vaccine knowledge, perceived susceptibility to infection, and vaccine efficacy and safety were positive correlates of vaccine uptake, risks from vaccination and vaccine efficacy were positive correlates of vaccine hesitancy.

**Conclusions:** Hesitancy in Hong Kong is more about vaccine efficacy and safety, and less about infection risks. Specifically, respondents expressed concerns about the particular vaccines supplied, especially BioNTech’s efficacy and risks from Sinovac. While higher risk motivates longer preparation for vaccine uptake, higher levels of benefits from BioNTech could reduce hesitancy.
of both BioNTech and Sinovac vaccines, deploying strategies such as lucky draws of coupons, electronic gifts and an apartment valued at HK$10.8 million [12]. Given all these initiatives and the low vaccination rate, this study identified factors associated with vaccine hesitancy to inform the implementation of strategies.

This study categorized vaccinated versus unvaccinated people and vaccine hesitancy according to the actual behaviours of the respondents. Researchers who have asked people about their intention to get vaccinated have considered those who answer “no” or “I don’t know” as likely vaccine hesitant [13]. This study contributes by investigating degrees of hesitancy to judge whether one is likely to take the vaccine within a month or longer. In Hong Kong, the government has informed the public that the end of August is the deadline for receiving the first dose of the BioNTech vaccine and that community centres will function until the end of September to complete second doses. This study asked respondents if they plan to take their first dose of the vaccine within the next month, two months, three months, three or more months, or if they will not consider taking it at all. Such an outcome variable of hesitancy allows researchers to explain what hesitancy is and identify what is associated with higher compared to lower degrees of hesitancy.

Three factors highlighted by the World Health Organization were perceived values of the vaccines, perceived obstacles to access the vaccines, and confidence in the vaccines [14]. Since vaccines could be easily accessed for free in Hong Kong, this study focused more on individuals’ perceptions of vaccine efficacy and risks. Referencing the 5C model in relation to vaccine hesitancy [15], this study focused on confidence (trust in vaccine effectiveness and safety), complacency (perceived susceptibility to infection and perceived disease risks) and calculation (knowing about the disease), among other Cs (constraints, such as affordability and accessibility, and vaccination as a collective responsibility). These factors are very similar to those of the Health Belief Model (HBM) used often to predict various vaccination behaviors [16,17], including COVID-19 vaccination [2]. Looking at calculation, complacency and confidence, the findings inform which factors associate with vaccine hesitancy in the city with the highest degrees of hesitancy.

**Material and Methods**

**Study setting**

This study collected data from a population-based online survey in Hong Kong from 22 to 30 June 2021 using quota sampling. Adults aged 18 years and older were invited to participate and were paid via a survey company, Dynata (previously known as SSI). Respondents were first asked to sign a consent form to ensure voluntary participation. The protocols were reviewed and approved by the Research Ethics Committee, Hong Kong Baptist University. As insufficient numbers of males and females aged 60 years and older were recruited, the remaining quotas (5%) were distributed equally across the other age groups. Since 1,730 individuals accessed the survey and 76 did not complete the survey, the final sample size was 1,654, including 872 females (52.7%). Respondents were between 18 and 68 years old (M = 38.7 years; SD = 21.55), with the majority (49.0%) having a bachelor’s degree and a mean monthly individual income of HK$20,000–HK$39,999. In general, they rated their health average on a 5-point scale from 1 = very weak to 5 = very strong (M = 3.19, SD = 0.76). Furthermore, 526 (31.8%) self-reported as pro-democracy, 257 (15.5%) as pro-establishment and the rest as independents. Given that the estimated sample size was 664 [18], calculated based on a response distribution of 50%, a confidence level of 99%, and a margin of error of 5%, with a total of 6,421,700 adults population living in Hong Kong, the sample obtained was more than required.

**Survey instrument**

Respondents were asked whether or not they had received their first dose of the COVID-19 vaccine. Those who answered “no” were then asked if they plan to take it in the next month, two months, three months, three or more months, or not planning to take it at all. Those who planned to take the vaccine were asked if they would choose BioNTech or Sinovac, the two vaccines available in Hong Kong. They were also asked to self-report their levels of knowledge of the two vaccines [19] (1 = extremely not knowledgeable, 2 = not knowledgeable, 3 = average knowledgeable, 4 = knowledgeable, 5 = extremely knowledgeable). Their perceived levels of efficacy and risk of the two vaccines were also captured. They were asked to what extent they agreed that BioNTech/Sinovac is safe, efficient [20], protective, backed up by science, supported by sufficient data for Ref. [21] and recognized internationally [22]. They were also asked to report their agreement in terms of BioNTech/Sinovac producing mild side effects (e.g. fever, chills, pain at the injection site) and severe side effects (e.g. severe allergic reactions, facial paralysis, blood clots) as documented by the World Health Organization [23]. Lastly, they were asked to report their perceived susceptibility to infection in Hong Kong [24] (1 = very low, 2 = low, 3 = average, 4 = high, 5 = very high), to estimate the risks from COVID-19 (long-term effects, death) from 0% (definitely will not happen) to 100% (definitely will happen) and to assess the risks from vaccination in general (side effects, long-term effects, death) from 0% to 100% (definitely will happen).

**Statistical analysis**

The data were analyzed using the Statistical Package of Social Sciences software version 27. Approximately 42.2% were vaccinated with their first dose of the COVID-19 vaccine and 27.6% were not planning to take the vaccine. Moreover, 10.2% planned to take it in the next month, 4.6% in the next two months, 3.2% in the next three months and 12.2% planned to take the vaccine after three months. In this sense, 30.3% of the sample were vaccine hesitant. A series of analyses of covariance (ANCOVAs) and pairwise comparisons (Bonferroni adjusted) were run, and differences with p < .05 considered as statistically significant.

**Results**

**COVID-19 vaccination hesitancy**

To assess differences between those who had been vaccinated, those who were hesitant and those who did not plan to get vaccinated, a series of ANCOVAs was run. As shown in Table 1, the groups differ in terms of all aspects except for risks from COVID-19 (p = .106). The results of further pairwise comparisons reveal that those not planning to get vaccinated differ significantly from the other two groups in many ways. In particular, vaccinated and hesitant respondents differ in terms of perceived risks and benefits of taking the specific vaccines. Those who had been vaccinated perceived BioNTech and Sinovac to be more beneficial than those who were hesitant (p < .001 and p < .001, respectively). The results are similar when applied to risks associated with BioNTech (p = .019) and Sinovac (p = .002) between vaccinated and hesitant respondents Table 2.

Focusing on the hesitants, another series of ANCOVAs and pairwise comparisons were performed to uncover differences among
the groups. The results show that respondents who planned to get vaccinated within a month and those who planned to delay vaccination by three months or more differ in terms of risks from COVID-19 (p =.030), perceived benefits of BioNTech (p <.001) and perceived benefits of Sinovac (p =.005).

Lastly, a series of multiple linear regressions was run with demographic and control variables (party identification and health status) in the first block, knowledge of the two vaccines in the second, coronavirus-related risks and general vaccination risks in the third, and BioNTech- and Sinovac-related benefits and risks in the fourth. All the models were run with vaccine hesitancy as the outcome variable. Larger numbers for vaccine hesitancy mean delay ing vaccination for a longer period. This outcome does not include those with no plans to get vaccinated.

None of the demographic and control variables were found to associate with vaccine hesitancy at a 0.05 significance level (see Table 3). Among respondents who planned to get vaccinated but had yet to do so, risks from vaccination in general significantly associated with higher degrees of hesitancy (i.e. longer preparation time; b = 0.14, p =.027). After adding risks and benefits associated with the two specific vaccines, hesitancy was found to relate positively to risks from Sinovac (b = 0.13, p =.009) and negatively to benefits of BioNTech (b = 0.24, p <.001).

Upon splitting the hesitant group in two according to choice of vaccine, similar patterns emerged with those who planned to take BioNTech, with risks from Sinovac positively related to hesitancy (b = 0.13, p =.015) and benefits of BioNTech negatively related to hesitancy (b = −0.28, p <.001). Among those who planned to take Sinovac, hesitancy related negatively with benefits of BioNTech (b = −0.23, p =.049) but not with risks from Sinovac itself.

**Discussion**

A good proportion of respondents – approximately 30.3% – satisfy the definition of vaccine hesitancy [4]. Such acceptance level was way lower than that of other countries such as Australia [25] and the United States [26]. By focusing on those who are considering vaccination and are planning to take the vaccine but are delaying this action, this study found that people hold significantly
different levels of perceived risks and benefits not in terms of vaccination and COVID-19 infection in general but relating to BioNTech’s and Sinovac’s effectiveness and risks. Such findings were consistent with what Wong et al. [27] have found, that safety and efficacy of vaccines were valued more than other factors such as the costs of the vaccines.

When controlling for many of the controls, such as sociodemographic factors, party identification and health status, vaccine knowledge was not a predictor of vaccine hesitancy. Acquiring more or less information about the specific vaccines did not help to reduce hesitancy. While knowledge has been widely cited as a reason for vaccine hesitancy among people in low-income regions [5], such a pattern did not seem to fit this case, which is a sample reason for vaccine hesitancy among people in low-income regions. While knowledge has been widely cited as a reason for vaccine hesitancy among people in low-income regions [5], such a pattern did not seem to fit this case, which is a sample reason for vaccine hesitancy among people in low-income regions.

When controlling for many of the controls, such as sociodemographic factors, party identification and health status, vaccine knowledge was not a predictor of vaccine hesitancy. Acquiring more or less information about the specific vaccines did not help to reduce hesitancy. While knowledge has been widely cited as a reason for vaccine hesitancy among people in low-income regions [5], such a pattern did not seem to fit this case, which is a sample reason for vaccine hesitancy among people in low-income regions. While knowledge has been widely cited as a reason for vaccine hesitancy among people in low-income regions [5], such a pattern did not seem to fit this case, which is a sample reason for vaccine hesitancy among people in low-income regions. When controlling for many of the controls, such as sociodemographic factors, party identification and health status, vaccine knowledge was not a predictor of vaccine hesitancy. Acquiring more or less information about the specific vaccines did not help to reduce hesitancy. While knowledge has been widely cited as a reason for vaccine hesitancy among people in low-income regions [5], such a pattern did not seem to fit this case, which is a sample reason for vaccine hesitancy among people in low-income regions.

When controlling for many of the controls, such as sociodemographic factors, party identification and health status, vaccine knowledge was not a predictor of vaccine hesitancy. Acquiring more or less information about the specific vaccines did not help to reduce hesitancy. While knowledge has been widely cited as a reason for vaccine hesitancy among people in low-income regions [5], such a pattern did not seem to fit this case, which is a sample reason for vaccine hesitancy among people in low-income regions. When controlling for many of the controls, such as sociodemographic factors, party identification and health status, vaccine knowledge was not a predictor of vaccine hesitancy. Acquiring more or less information about the specific vaccines did not help to reduce hesitancy. While knowledge has been widely cited as a reason for vaccine hesitancy among people in low-income regions [5], such a pattern did not seem to fit this case, which is a sample reason for vaccine hesitancy among people in low-income regions. When controlling for many of the controls, such as sociodemographic factors, party identification and health status, vaccine knowledge was not a predictor of vaccine hesitancy. Acquiring more or less information about the specific vaccines did not help to reduce hesitancy. While knowledge has been widely cited as a reason for vaccine hesitancy among people in low-income regions [5], such a pattern did not seem to fit this case, which is a sample reason for vaccine hesitancy among people in low-income regions. When controlling for many of the controls, such as sociodemographic factors, party identification and health status, vaccine knowledge was not a predictor of vaccine hesitancy. Acquiring more or less information about the specific vaccines did not help to reduce hesitancy. While knowledge has been widely cited as a reason for vaccine hesitancy among people in low-income regions [5], such a pattern did not seem to fit this case, which is a sample reason for vaccine hesitancy among people in low-income regions.


**Ethics approval**
Ethics approval granted by the Research Ethics Committee of Hong Kong Baptist University (REC/20-21/0029).

**References**

[1] Sanchez S, Lin YT, Xu C, Romero-Severson E, Hengartner N, Ke R. High contagiousness and rapid spread of severe acute respiratory syndrome coronavirus 2. Emerg Infect Dis 2020;26(7):1470–7.

[2] Wang K, Wong E-Y, Ho K-F, Cheung A-L, Yau P-Y, Dong D, et al. Change of willingness to accept COVID-19 vaccine and reasons of vaccine hesitancy of working people at different waves of local epidemic in Hong Kong, China: repeated cross-sectional surveys. Vaccines 2021;9(1):62. https://doi.org/10.3390/vaccines9010062.

[3] CU Medicine. CU medicine survey shows only 25% of unvaccinated people intend to get inoculated in the coming six months. Press Releases; 2021. <https://www.cpr.cuhk.edu.hk/en/press/cu-medicine-survey-shows-only-25-of-unvaccinated-people-intend-to-get-inoculated-in-the-coming-six-months/).

[4] Wong MCS, Wong ELY, Huang J, Cheung AWL, Law K, Chong MKC, et al. Acceptance of the COVID-19 vaccine based on the health belief model: a population-based survey in Hong Kong. Vaccine 2021;39(7):1148–56.

[5] Larson HJ, Jarrett C, Ekersberger E, Smith DMD, Paterson P. Understanding vaccine hesitancy around vaccines and vaccination from a global perspective: a systematic review of published literature, 2007–2012. Vaccine 2014;32(19):2150–9.

[6] Lin C, Tu P, Beitsch LM. Confidence and receptivity for COVID-19 vaccines: a rapid systematic review. Vaccines 2021;9(1):16.

[7] Department of Health, HK SAR. Centre for health protection – vaccination schemes – children aged below 12/students attending a primary school of Hong Kong. Retrieved September 18, 2020. <https://www.chp.gov.hk/en/features/18877.html> [accessed on 16 September, 2020].

[8] Mustapha T, Khubchandani J, Biswas N. COVID-19 vaccination hesitancy in students and trainees of healthcare professions: a global assessment and call for action. Brain Behav Immun Health 2021;16:100289. https://doi.org/10.1016/j.bbih.2021.100289.

[9] MacDonald NE. Vaccine hesitancy: definition, scope and determinants. Vaccine 2015;33(34):4161–4.

[10] GovHK. Govt explains vaccine surplus plan. News.gov.hk. 2021 May 25. <https://www.news.gov.hk/eng/2021/05/20210525/20210525_225720_687.html>.

[11] Cheung E, Lee D. Hong Kong expands coronavirus vaccination programme to those aged under 30; BioNTech shots to close in September. South China Morning Post. 2021 April 15. <https://www.scmp.com/news/hong-kong/health-environment/article3129620/hong-kong-expand-coronavirus-vaccination-programme>.

[12] Longchamps C, Ducarroz S, Crouzet L, Vignier N, Pourtau L, Allaire C, et al. COVID-19 vaccine hesitancy among persons living in homeless shelters in France. Vaccine 2021;39(25):3315–8.

[13] WHO. SAGE Working Group Dealing with Vaccine Hesitancy; WHO: Geneva, Switzerland; 2015.

[14] Kwok HW, Lin KY, Wei WI, Tang A, Wong SYS, Lee SS. Influenza vaccine uptake, COVID-19 vaccination intention and vaccine hesitancy among nurses: a survey. Int J Nurs Stud 2021;114:103854. https://doi.org/10.1016/j.ijnurstu.2020.103854.

[15] Santos AJ, Kislaya I, Machado A, Nunes B. Beliefs and attitudes towards the influenza vaccine in high-risk individuals. Epidemiol Infect 2017;145(9):1786–96.

[16] Rajamooorthy Y, Radam A, Taib NM, Rahim KA, Wagner AL, Mudatsir M, Munusamy S, Harapan H. The relationship between perceptions and self-paid hepatitis B vaccination: a structural equation modeling approach. PloS One 2018;13(12):e0208402.

[17] Raosoft Inc. RaoSoft® Sample Size Calculator: 2004. <http://www.raosoft.com/samplesize.html> [accessed March 18, 2020].

[18] Mongkho MY, Mushij BJ, Thomas R. Perception of HIV/AIDS and socio-cognitive determinants of safe sex practices among college students attending a historically black college and university in the United States of America. J AIDS HIV Res 2010;23(3):392–47.

[19] Masson CL, McCusian S, Straus E, Elahi S, Chen M, Gruber VA, et al. COVID-19 vaccine trust among clients in a sample of California residential substance use treatment programs. Drug Alcohol Depend 2021;225:108812. https://doi.org/10.1016/j.drugalcdep.2021.108812.

[20] Koh Doherty TM, Hausdorff WP, Kristinsson KG. Effect of vaccination on the use of antimicrobial agents: a systematic literature review. Ann Med 2020;52(6):283–99.

[21] Goel RK, Nelson MA, Goel VY. COVID-19 vaccine rollout—scale and speed carry different implications for corruption. J Policy Model 2021;43(3):501–20.

[22] World Health Organization. Side effects of COVID-19 vaccines. <https://www.who.int/news-room/feature-stories/detail/side-effects-of-covid-19-vaccines#> [accessed March 17, 2021].

[23] World Health Organization. Side effects of COVID-19 vaccines. <https://www.who.int/news-room/feature-stories/detail/side-effects-of-covid-19-vaccines#> [accessed March 17, 2021].

[24] Venema TAG, Pfattheicher S. Perceived susceptibility to COVID-19 infection and narcissistic traits. Personal Individ Differ 2021;175:110696. https://doi.org/10.1016/j.paid.2021.110696.

[25] Dodd RH, Cvejic E, Bonner C, Pickles K, McCaffery KJ. Sydney Health Literacy Lab COVID-19 group (2020). Willingness to vaccinate against COVID-19 in Australia. Lancet Infectious Diseases. https://doi.org/10.1016/S1473-3099(20)30559-4.

[26] Malik AA, McFadden SM, Elbarake J, Omer SB. Determinants of COVID-19 vaccine acceptance in the US. EClinicalMedicine 2020;26:100495. https://doi.org/10.1016/j.eclinm.2020.100495.

[27] Weng LP, Aliah H, Wong P-F, Lee HY, AbuBakar S. The use of the health belief model to assess predictors of intent to receive the COVID-19 vaccine and willingness to pay. Human Vac Immunother 2020;16(9):2204–14.

[28] Neumann-Böhme S, Varghese NE, Sabat I, Barros PP, Brouwer W, van Exel J, et al. Once we have it, will we use it? A European survey on willingness to be vaccinated against COVID-19. Eur J Health Econ 2020;21(7):977–82. https://doi.org/10.1007/s10198-020-01208-6.

[29] Feng S, Shen C, Xia N, Song W, Fan M, Cowling BJ. Rational use of face masks in the COVID-19 pandemic. Lancet Respir Med 2020;8(5):434–6.

[30] Eskola J, Duclos P, Schuster M, MacDonald NE. The SAGE working group on vaccine hesitancy. How to deal with vaccine hesitancy? Vaccine 2015;33(34):4215–7.

[31] Marti M, de Cola M, MacDonald NE, Dumordal L, Duclos P, Borrow R. Assessments of global drivers of vaccine hesitancy in 2014—looking beyond safety concerns. PLoS ONE 2017;12(3):e0172310. https://doi.org/10.1371/journal.pone.0172310.

[32] Rozeck L, Jones P, Menon AR, Hicken A, Apsey L, King E. Understanding vaccine hesitancy in the context of COVID-19: the role of trust and confidence in a seventeen-country survey. Int J Public Health 2021 May;14(6):48.