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

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ABSTRACT

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.

Introduction

While an uptake of at least 55% is estimated to accomplish herd immunity against COVID-19 [1], reports have shown that Hongkongers are hesitant to take the COVID-19 vaccine [2], with only 25% of unvaccinated people planning to get vaccinated in the coming six months [3]. Studies have shown that a major barrier to uptake included the failure to build confidence in vaccine manufacturers [4], and can in turn pose challenges to the success of vaccination campaigns and herd immunity [5]. In fact, vaccine hesitancy is not only an issue in Hong Kong but a global concern [6]. That particular study on COVID-19 [4] was conducted in July 2020, prior to the vaccination period and studying intention to be vaccinated in general terms. As vaccination intention does not always translate to action [7], the present study aimed to complement the previous one by assessing (1) how vaccinated and hesitant people differ and (2) what factors contribute to a longer vaccination delay among the hesitants.

As of 4 July 2021, only 34.8% of Hongkongers have received their first dose of either the BioNTech or Sinovac COVID-19 vaccine. According to a global review on COVID-19 vaccine hesitancy [8], this term can refer to the refusal to receive a COVID-19 vaccine. In fact, the World Health Organization has defined refusal or delay to get vaccinated as vaccine hesitancy [9]. Here, the emphasis is on the latter – postponing the decision to get vaccinated. The Hong Kong government has made considerable effort to increase the vaccination rate. It has announced that there is a surplus of BioNTech vaccines which are going to expire [10] and community centres used for vaccination that will close [11] if the vaccination rate remains low. Businesses are also active in promoting the uptake

Abbreviations: COVID-19, Coronaricus disease 2019.

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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 above 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

Table 1
F-statistics, means and standard deviations for the three vaccination groups.

	F (df_1, df_2)	Vaccinated (n = 698)	Hesitants (n = 500)	No plans to get vaccinated (n = 456)
Knowledge of BioNTech	30.92*** (1, 1645)	3.46[a] (0.86)	3.07[b] (0.68)	2.97[a,b] (0.86)
Knowledge of Sinovac	34.26*** (1, 1645)	3.40[c] (0.92)	2.98[d] (0.72)	2.87[c,d] (0.95)
Perceived susceptibility to infection	6.82** (1, 1645)	2.85[e] (1.00)	2.67[f] (0.74)	2.64[e,f] (0.83)
Risks from coronavirus	2.25 (1, 1645)	48.65 (22.95)	48.51 (19.75)	50.97 (21.12)
Risks from vaccination in general	41.84*** (1, 1645)	36.22 [g] (25.98)	38.38 [h] (19.73)	49.56 [g,h] (22.43)
Benefits of BioNTech	92.30*** (1, 1645)	3.70[i,j] (0.69)	3.47[j,k] (0.53)	3.11[i,k] (0.76)
Benefits of Sinovac	156.36*** (1, 1645)	3.25 [l,m] (0.94)	2.71 [m,n] (0.76)	2.16 [l,n] (0.86)
Risks from BioNTech	6.83** (1, 1645)	3.23[o,p] (0.77)	3.33[o] (0.57)	3.37[p] (0.67)
Risks from Sinovac	26.88*** (1, 1645)	3.12[q,r] (0.84)	3.25[q,s] (0.67)	3.50[r,s] (0.91)

Notes. ** p <.01. *** p <.001. [a–s] Mean is statistically different from the mean of the relevant comparison group indicated by the same letter at a 0.05 significance level. Standard deviations are reported in brackets. All comparisons controlled for gender, age, education, income, party identification and health status.

Table 2
F-statistics, means and standard deviations for the four vaccine-hesitant groups.

	F (df_1, df_2)	Within one month (n = 169)	Within two months (n = 76)	Within three months (n = 53)	Three or more months (n = 202)
Knowledge of BioNTech	2.11 (3, 490)	3.18 (0.70)	3.09 (0.70)	3.09 (0.66)	2.96 (0.66)
Knowledge of Sinovac	2.49 (3, 490)	3.10 (0.75)	3.05 (0.73)	2.92 (0.81)	2.87 (0.65)
Perceived susceptibility to infection	0.58 (3, 490)	2.60 (0.77)	2.68 (0.75)	2.68 (0.70)	2.71 (0.71)
Risks from coronavirus	1.45 (3, 490)	42.45 (19.10)	41.36 (20.27)	44.95 (20.66)	45.69 (21.12)
Risks from vaccination in general	3.03* (3, 490)	35.62[a] (20.37)	36.62 (17.39)	37.99 (18.40)	41.60[a] (20.08)
Benefits of BioNTech	12.06*** (3, 490)	3.62[b] (0.52)	3.49[c] (0.47)	3.54[d] (0.56)	3.32[b,c,d] (0.50)
Benefits of Sinovac	4.98** (3, 490)	2.87[e,f] (0.83)	2.59[e] (0.64)	2.74 (0.75)	2.61[f] (0.73)
Risks from BioNTech	1.05 (3, 490)	3.34 (0.58)	3.22 (0.48)	3.35 (0.61)	3.36 (0.57)
Risks from Sinovac	3.18* (3, 490)	3.17 (0.71)	3.11 (0.50)	3.38 (0.66)	3.34 (0.67)

Notes. * p <.05. ** p <.01. *** p <.001. [a–f] Mean is statistically different from the mean of the relevant comparison group indicated by the same letter at a 0.05 significance level. Standard deviations are reported in the brackets. All comparisons controlled for gender, age, education, income, party identification and health status.

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 delaying 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

Table 3
Regression analysis summary for predicting vaccine hesitancy.

	Everyone who is hesitant		People who plan to take BioNTech	People who plan to take Sinovac
Gender	−0.04	−0.04	−0.05	−0.02
Age	−0.02	0.00	−0.01	0.02
Education	−0.04	−0.05	−0.04	−0.18
Income	−0.03	−0.02	−0.02	0.05
Party identification	−0.04	−0.04	−0.04	0.13
Health status	−0.05	−0.05	−0.06	0.03
R^2 change (%)	1.7	1.7	1.2	3.8
Knowledge of BioNTech	−0.07	−0.01	−0.04	−0.17
Knowledge of Sinovac	−0.08	−0.08	−0.02	−0.10
R^2 change (%)	1.6	1.6	1.3	4.7
Perceived susceptibility to infection	0.03	0.01	0.04	−0.07
Risks from coronavirus	−0.01	−0.01	−0.07	0.17
Risks from vaccination in general	0.14*	0.05	0.07	−0.01
R^2 change (%)	1.8	1.8	2.0	3.5
Risks from BioNTech		0.01	0.02	−0.02
Risks from Sinovac		0.13**	0.13*	0.11
Benefits of BioNTech		−0.24***	−0.28***	−0.23*
Benefits of Sinovac		−0.06	−0.02	0.03
R^2 change (%)		6.2	7.2	5.2
Total adjusted R^2	3.0	8.6	8.1	5.1

Notes. * p <.05. ** p <.01. *** p <.001.

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 from a high-income region. Moreover, even though prior studies have found politics to play a significant role in predicting vaccine hesitancy [28], this study did not find party identification to associate with hesitancy. These findings do not deny the role of politics completely; however, politics did not seem to be functional on top of perceived vaccine efficacy and safety. In addition, susceptibility to infection and risks associated with COVID-19 were not found to predict hesitancy. This rejects the hypothesis that Hongkongers are hesitant due to low risk of infection and fear of the outcomes of COVID-19 infection. Instead, this supports "risk alone cannot stimulate policy compliance" [29].

Overall, the findings suggest that hesitancy in Hong Kong is about vaccine efficacy and safety, similar to previous findings [2,30–32], but not vaccination risks in general. Specifically, respondents expressed concerns about the particular vaccines supplied in the city, 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. It is therefore vital for researchers and practitioners to distinguish concepts such as efficacy associated with a specific vaccine, efficacy associated with vaccination in general, risks associated with a specific vaccine, and risks associated with vaccination in general.

It should be noted that, vaccine uptakes have risen since this survey was conducted, and that implications of the findings might not inform public policy two to three months later. In addition, this study relied on self-reports. Even though online surveys should be able to minimize biases such as social desirability, future studies should seek to generate results by means of actual vaccination behaviors. Lastly, while the associations among the variables of interest were identified, no conclusions on causal relationships caution should be derived owing to the cross-sectional study design.

Conclusions

The findings of the current study, therefore, provide evidence to argue against evaluating each vaccine using the same predictors. In addition, this study contributes by inspecting hesitancy as an outcome variable with different levels of hesitancy, rather than asking respondents a "yes" or "no" question [9]. Given the above results, vaccination programmes should focus on promoting the effectiveness of COVID-19 vaccines to motivate their uptake but not emphasize raising risk perceptions of COVID-19 as a disease (chance of infection as well as negative consequences of COVID-19 infection).

Author contributions.
(1) Concept or design: SJT.
(2) Acquisition of data: SJT.
(3) Analysis or interpretation of data: SJT.
(4) Drafting of the article: SJT.
(5) Critical revision for important intellectual content: SJT.
The author had full access to the data, contributed to the study, approved the final version for publication, and take responsibility for its accuracy and integrity.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Ethics approval

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