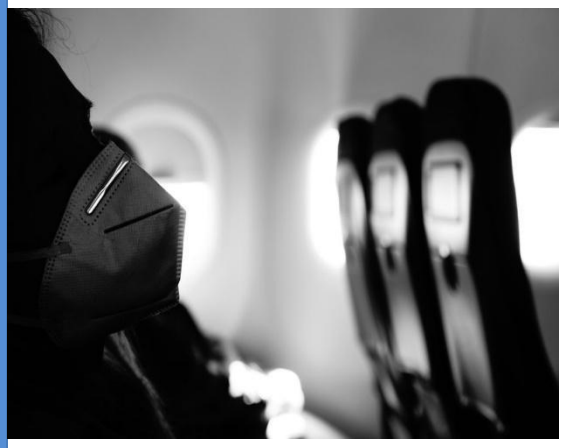
Public Perception and Ethical Acceptability of Surveillance, Monitoring and Health Certification Measures for International Travel During COVID-19: Surveys in Singapore, Hong Kong, and Malaysia



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Public Perception and Ethical Acceptability of Surveillance, Monitoring and Health Certification Measures for International Travel During COVID-19: Surveys in Singapore, Hong Kong, and Malaysia

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Summary

Safe movement and international travel during the COVID-19 pandemic could be facilitated by public health surveillance in combination with monitoring and certification tools and policies. These measures include digital contact tracing, wearable quarantine monitoring devices, COVID-19 tests and also COVID-19 vaccination. To study public perceptions of these measures to facilitate international travel during the COVID-19 pandemic, we conducted surveys in three sites: Singapore, Hong Kong and Malaysia. The goal of this research was to understand public perceptions on the ethical acceptability of digital contact tracing, wearable quarantine monitoring devices, COVID-19 testing and vaccination measures in the context of international travel during or after the COVID-19 pandemic.

The surveys were conducted in December 2020 with adult participants using a self-administered online questionnaire. The research team included experts in public health and data ethics and those with expertise in quantitative survey design. The questionnaire was divided into six sections that probed general vaccine sentiment and public opinion on digital contact tracing, wearable monitoring devices, COVID-19 testing for travelers as well as COVID-19 vaccination for travelers based on two different scenarios.

Survey participants in Singapore were recruited through the Singapore Population Health Improvement Centre (SPHERiC) Online Panel managed by the National University Health System, which has 2,500 English-literate Singaporeans or permanent residents. In Malaysia, the survey was administered by a professional market surveyor. Participants answered the questionnaire via an online platform following recruitment at public spaces with strict adherence to safe distancing. In Hong Kong, survey participants were recruited through the probability-based panel of the Hong Kong Public Opinion Research Institute, which includes around 8,500 Cantonese- or English-literate Hong Kong citizens. There were 982 respondents in Singapore, 1956 in Malaysia and 669 in Hong Kong.

In our study, we observed differences between the three settings with respect to confidence in the effectiveness of digital contract tracing: respondents from Hong Kong were much more likely to think that digital contact tracing was ineffective and that there were insufficiently strict rules to prevent contact tracing data from being used for other purposes. In contrast, Singapore and Malaysia respondents expressed relatively high levels of confidence in the effectiveness of digital contact tracing and both groups strongly endorsed the view that the benefits of such technology outweigh the risks. Respondents from Malaysia thought digital contact tracing was effective and on balance beneficial, but did not endorse mandatory use, while in Singapore, respondents displayed stronger support for mandatory use of digital contact tracing technology.

Public perception of monitoring devices to support quarantine orders also differed by setting. A large majority of respondents in Singapore and Malaysia endorsed use of such devices. By comparison, respondents from Hong Kong were more likely to think that monitoring devices were unreasonable, ineffective and unnecessary. This explains why Hong Kong respondents objected more strongly to mandatory use of monitoring devices for incoming travelers. Interestingly, Hong Kong respondents were more comfortable with the use of home monitoring devices for people serving quarantine notices at home or in a hotel than with digital contact tracing technology. This may indicate that in Hong Kong, the public's concern is primarily with the prospect of government tracking of movement in the community and public spaces.

Respondents from Singapore and Malaysia demonstrated higher overall confidence in vaccines compared to those in Hong Kong. Despite this, willingness to be vaccinated against COVID-19 was similar in all three settings, with more than half to two-thirds of respondents across settings expressing willingness to be vaccinated. However, a substantial fraction of respondents in all three settings were undecided. This may suggest a lack of clarity among the public about how vaccination policies should work. It may also indicate that clear communication about policies and their rationale might be necessary for travel-related vaccination strategies.

Perceptions of equity implications of vaccination policies were mixed. Around a half of respondents in all three settings agreed that banning unvaccinated people from travelling internationally would be unfair. The majority of respondents in all three settings also agreed that it was reasonable to place different restrictions on vaccinated and unvaccinated travelers. Our results also show strong agreement in all three settings with the view that it is reasonable to place different restrictions on vaccinated and unvaccinated travelers. Allowing unvaccinated and vaccinated individuals to travel under different least restrictive conditions (consistent with minimizing public and individual health risks) would be equitable and respects individual freedom of movement. Our study also suggests substantial barriers to travel for many individuals in Singapore and Malaysia if they were to bear the financial costs of COVID-19 testing. The same issue may extend to COVID-19 vaccination. Policy-makers could consider subsidizing such costs or capping their price to allow as many individuals as possible to travel, especially if these measures remain or become a requirement for international travel during or after the COVID-19 pandemic.

The success of a public health strategy depends as much on the context as the intervention itself. The information from this study is important as it shows that the ethics of surveillance,

monitoring and health certification interventions for international travel will be context sensitive, contingent on a country's specific pandemic situation, inequalities, power structures, legal protections, amongst other factors. Our research also demonstrates the importance of background political and social conditions in people's perception of public health interventions. For example, respondents from Hong Kong viewed contact tracing technology as less effective than respondents from Malaysia or Singapore. The effectiveness of the technology used for digital contact tracing in these three settings is unlikely to differ significantly. This difference in perception of effectiveness may instead reflect a broader lack of trust in political institutions and data security in Hong Kong.

Based on our study and its insights, we propose the following recommendations:

- Effective public health strategies need to be targeted to the particular context. Countries should, where possible, conduct local research to better understand and respond to specific local concerns, rather than rely on qualitative research from other countries or pre-pandemic.
- It is important that the public understands why and how decisions about surveillance, monitoring and health certification in the context of international travel have been made, including how specific trade-offs have been managed. Transparent, consistent and clear public health communication on the ethical bases and implementation details (e.g. data minimization and protection) of these measures would be critical to securing public acceptability and compliance with these measures for international travel and other purposes.
- Policy-makers should consider the equity implications for different COVID-19 policies and where possible avoid, mitigate or compensate for any newly generated inequalities or vulnerabilities arising from public health strategies in the context of international travel. For example, if vaccination is required for international travel this could have disadvantage people who, for medical reasons, are advised not to be vaccinated.
- International cooperation and coordination will be essential to establish common standards and integrated approaches to COVID-19 vaccination certification in the context of international travel. Ethical governance of COVID-19 vaccination certificates for travel purposes should protect not just the right to obtain and hold a vaccination certificate (WHO 2020a) but also the right to travel without one.

Background

Various public health surveillance, monitoring and health certification strategies have been trialed, implemented and proposed as part of the global effort to contain and manage SARS-CoV-2 spread. Surveillance and certification tools and policies aim to facilitate the relaxation of restrictions on individual movement, including international travel. For example, Singapore has used health certificates (based on COVID-19 negative tests) as well as digital contact tracing to minimize the risk of imported cases from overseas and onward local transmission by travelers (Toh 2020; Ministry of Health 2020). With the anticipated global deployment of COVID-19 vaccines in 2021, it is possible that vaccination certification will also be used to ease or lift movement and travel restrictions. Currently, yellow fever is the only disease explicitly listed in the International Health Regulations (IHR) (2005) for which countries can require proof of vaccination from travelers as a condition of entry. However, the WHO is organizing an expert 'Smart Vaccination Certificate Consortium' to establish key specifications, standards and a trust framework for a digital vaccination certificate to support the monitoring of national COVID-19 vaccination programs and "cross-border uses architected for a potential future in which the COVID-19 vaccine would be included in an updated version of the International Health Regulations" (WHO 2020a). In other words, as provided for by the International Health Regulations, the WHO is carrying out its mandate to coordinate and equip member states with technical and governance standards for the implementation of COVID-19 vaccination as a requirement for travelers to enter a country. Ahead of such a development, the national airline of Singapore is trialing an app for the digital verification of COVID-19 test results and vaccination certificates to facilitate international air travel recovery (Channelnewsasia 2020).

According to the World Health Organization, surveillance and certification measures for international travel should be "proportionate to public health risks and should be adjusted based on a risk assessment, conducted regularly and systematically as the COVID-19 situation evolves and communicated regularly to the public" (WHO 2020b). Such measures should also be based on ethical principles and considerations such as equitable distribution of benefits and burdens, and balance competing ethical values. Individual and public support is important both ethically and pragmatically. For example, impediments to liberty and intrusions of privacy should be reasonable and proportionate to the anticipated public benefits. Public health policies should broadly align with public values to demonstrate respect for individuals and democratic principles. Furthermore, public health strategies depend primarily on public cooperation and compliance with control measures.

The ethical implications of surveillance, monitoring and health certification strategies have been discussed by others (Mello & Wang 2020; Xafis et al. 2020; WHO 2020c). However, there has been limited empirical work on public perception and acceptance of these strategies (Abuhammad, Khabour & Alzoubi 2020; Guillon & Kergall 2020; Mayssam et al. 2020; O'Callaghan et al. 2020), particularly in the international travel context. Our study seeks to understand public perceptions on the ethical acceptability of digital contact tracing, wearable quarantine monitoring devices, COVID-19 testing and vaccination measures in the context of international travel during and after the COVID-19 pandemic.

Methods

Study Population

In Singapore, survey participants were recruited through the Singapore Population Health Improvement Centre (SPHERiC) Online Panel, managed through the National University Health System to facilitate the dissemination of online surveys on wide-ranging topics concerning public health. The online panel comprises 2,500 English-literate Singaporeans or permanent residents who are aged 21 years and above. Members of the online panel were invited to take part in the survey via email or SMS sent on December 11, 2020. The invitation contained information regarding the purpose of the survey and a link to the questionnaire. The survey was administered in English through a web-based using the REDCap platform and took approximately 10 minutes to complete. A SGD$5 reimbursement was provided for completing the survey. Participants were given 10 days to complete the survey. A reminder was sent to participants who had not completed the e-questionnaire within 5 days. Data were anonymized prior to analysis.

In Malaysia, a market surveyor conducted the survey in English. Survey participants were Malaysians aged 18 years old and above, and purposively sampled to represent a mix of gender, ethnicities and locality (urban and sub-urban). Participant recruitment was conducted at public spaces such as shopping malls, community town-halls and residential halls with strict adherence to the standard operating procedure for safe distancing. The data collection was completed within five days (from 11th to 15th December 2020). All participants provided electronic consent and each participant took between 10 to 15 minutes to answer the questionnaire via an online link. No identifiable information was captured during the survey.

In Hong Kong, survey participants were recruited through the probability-based panel of the Hong Kong Public Opinion Research Institute. The panel includes 8,500 Cantonese- or English-literate Hong Kong citizens aged 18 years or above who are representative of specific sectors of the Hong Kong population. The survey invitations were sent to half of the members of the probability-based

panel via email on November 30, 2020 and the other half of the members on December 8, 2020. Reminders were sent to those who had not completed the questionnaire by December 10, 2020. The invitation contained information regarding the purpose of the survey and a link to the e-questionnaire. The online platform was open until December 20, 2020. All questionnaires were self-administered by the respondents and submitted anonymously.

Survey Questionnaire

The questionnaire was divided into six sections that probed general vaccine sentiment and public opinion on digital contact tracing, wearable monitoring devices, COVID-19 testing for travelers as well as COVID-19 vaccination for travelers. Investigators/research staff from the National University of Singapore – who are content expert on the ethical issues or have expertise in quantitative survey design – designed the questionnaire. The survey instrument underwent pilot-testing (trial run) with a small number of test participants in Singapore to test the appropriateness and comprehension of the questions, and evaluate whether the instrument would meet the study objectives.

To measure general vaccine sentiment, we adapted the global vaccine confidence index developed by the Vaccine Confidence Project at the London School of Hygiene & Tropical Medicine (Larson et al. 2016). Respondents were asked to rate, on a 5-point Likert scale (from strongly disagree to strongly agree), the degree to which they believe statements pertaining to vaccine effectiveness, safety, importance as well as religious compatibility. To assess whether responses were influenced by the placing of questions on vaccine confidence, we used two versions of the questionnaire in which the vaccine confidence questions were placed at the beginning and at the end of the e-questionnaire respectively. Each version was administered to half of the respondents at random in each site. Respondents were also asked whether they would be willing to take a COVID-19 vaccine once it became available. In addition, we asked participants how worried they would be if they or their families would get infected in the next 12 months, and how confident they were that they could protect themselves from the infection.

To measure public opinion on the use of digital contact tracing, participants were asked to register their level of agreement with a series of statements using a 5-point Likert response scale. These statements pertained to acceptance and perceived benefits of digital contact tracing (individual as well as social benefits), perceived barriers (such as privacy concerns raised by the use of such apps and devices) and operational control of digital contact tracing programs (for example, trust in government authorities versus private companies). Participants were also asked about their

preference between a wearable device and a mobile application and the features of each that they would deem important.

This was followed by measurement of public opinion on wearable monitoring devices that are used to monitor travelers placed under quarantine. We assessed acceptance and perceived benefits of using wearable monitoring devices (individual and social benefits), along with perceived barriers (such as infringement of personal freedom) and preferred placement position (ankle versus wrist).

We assessed implications of COVID-19 testing for travel by asking respondents if it is reasonable to require COVID-19 testing for travel, whether such a mandate increases or decreases their likelihood of travel, whether the cost of testing should be borne by the traveler or the government and how this influences their travel prospects. Furthermore, we asked respondents whether it was reasonable to exempt travelers who test negative from additional measures such as quarantine and digital contact tracing.

To measure public perception of policies related to COVID-19 vaccination for travel, we used two different scenarios: in the first, participants were asked to imagine that a COVID-19 vaccine had been approved for general use and is widely available, while in the second participants were asked to imagine that a COVID-19 vaccine had been approved but was in limited supply. The questions under each scenario were the same and the two scenarios were administered to randomly selected subsets of survey participants, to allow for comparison of whether vaccine availability influences people's perception of vaccination policies. For instance, we asked participants if they thought it would be reasonable to allow travel only for vaccinated individuals or that additional restrictions be placed on unvaccinated travelers. We asked participants whether asking travelers to bear the expense of vaccination was justifiable. Lastly, to measure vaccination intention, we asked participants if they would be willing to get a COVID-19 vaccine to travel abroad.

Data Analysis

We assessed representativeness of our samples by comparing the sociodemographic characteristics of the survey sample from each site with those from their national census in terms of age group, gender, ethnicity, educational level, and socioeconomic status.

Ethics Statement

Study protocols were approved by the following ethics bodies: Departmental Ethics Review Committee of the Saw Swee Hock School of Public Health, National University of Singapore (SSHSPH-092); Universiti Malaya Research Ethics Committee (UM.TNC2/UMREC_1129); and,

Institutional Review Board of the University of Hong Kong and Hospital Authority Hong Kong West Cluster (UW-20-095).

Results

There were a total of 982 eligible respondents in Singapore, 1956 in Malaysia and 669 in Hong Kong. In Singapore, the survey sample was comparable to the census population in terms of marital status and housing type, but there was an over-representation of females and those with post-secondary and tertiary education, while those of Malay ethnicity and people in the highest income bracket were under-represented. In the Malaysia sample, those aged 30-49 years, females, those of Chinese ethnicity, unmarried individuals and those living in condominiums or single occupancy housing were over-represented compared to the census population. In Hong Kong, the survey sample comprised proportionately more males, people with tertiary education, people in the highest income bracket and those living in public housing (Appendix Tables 1-3).

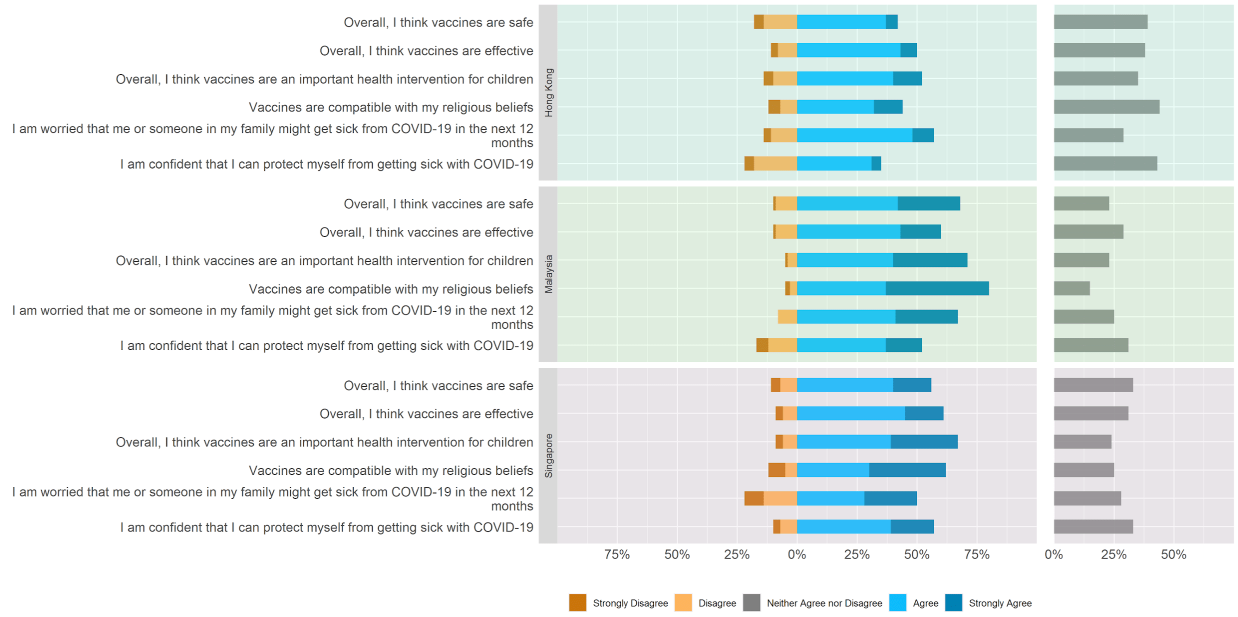
Concern about COVID-19 and self-efficacy

Concern about acquiring COVID-19 was high in all three settings with at least half of respondents in all three settings expressing worry about getting sick with COVID-19 in the next 12 months. Respondents in Hong Kong, however, displayed lower self-efficacy, with about a third stating that they were confident of being able to protect themselves against COVID-19, compared with around a half of respondents in Malaysia and Singapore.

Vaccine confidence

In general, vaccine confidence was higher in Malaysia compared with Singapore and Hong Kong. Around two-thirds of respondents in Malaysia agreed that vaccines are safe, effective and an important health intervention for children. In addition, >75% agreed that vaccines are compatible with their religious beliefs. This figure was higher than in both Singapore and Hong Kong, where less than two-thirds and less than half of respondents respectively felt that vaccines were compatible with their religious beliefs. Further, confidence in vaccines was considerably lower among Hong Kong respondents, with about 4 in 10 agreeing that vaccines are safe and around half believing that vaccines are effective and an important health intervention for children.

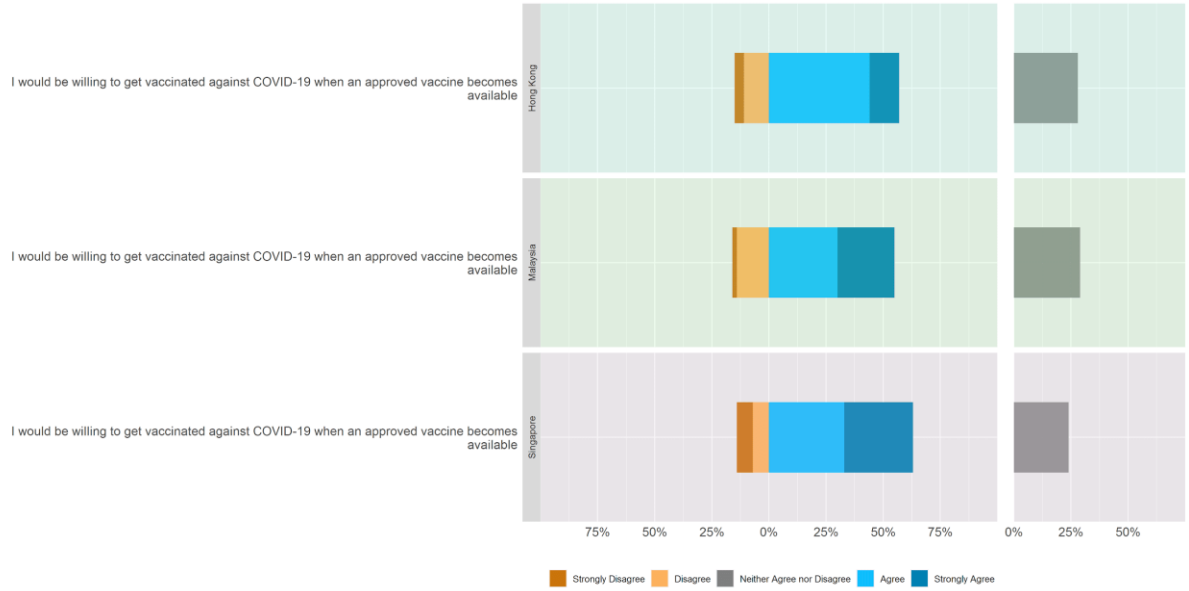
Figure 1 Vaccine confidence and related concerns and beliefs



Willingness to be vaccinated against COVID-19

Across all three settings, two-thirds or fewer respondents said that they would be willing to be vaccinated against COVID-19 when an approved vaccine became available. Notably, about a quarter of respondents in all three settings neither agreed nor disagreed with this statement, possibly reflecting a substantial fraction of undecided individuals.

Figure 2 Willingness to be vaccinated against COVID-19



Willingness to vaccinate was strongly associated with vaccine confidence in all three settings (Appendix Table 4).

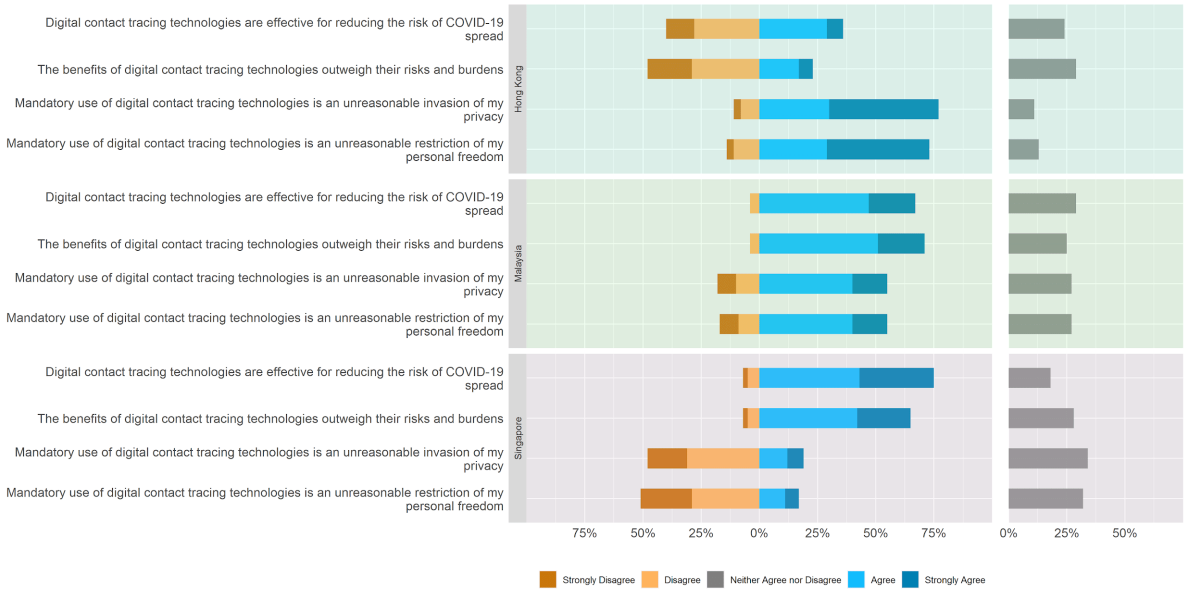
Digital contact tracing

In general, respondents in Singapore demonstrated greater support for digital contact tracing technologies compared with the other two settings. Around 75% of Singapore respondents believed that digital contact tracing was effective at reducing the risk of COVID-19 spread and around two-thirds felt that the benefits of digital contact tracing outweighed the harms. About a fifth of respondents agreed that mandatory use of digital contact tracing was an unreasonable invasion of privacy and an unreasonable restriction of personal freedom.

In contrast, around three-quarters of respondents in Hong Kong believed that mandatory use of digital contact tracing was an unreasonable invasion of privacy and restriction of personal freedom, while a quarter agreed that the benefits outweighed the risks and a third believed such technologies to be effective at reducing risk of COVID-19 spread.

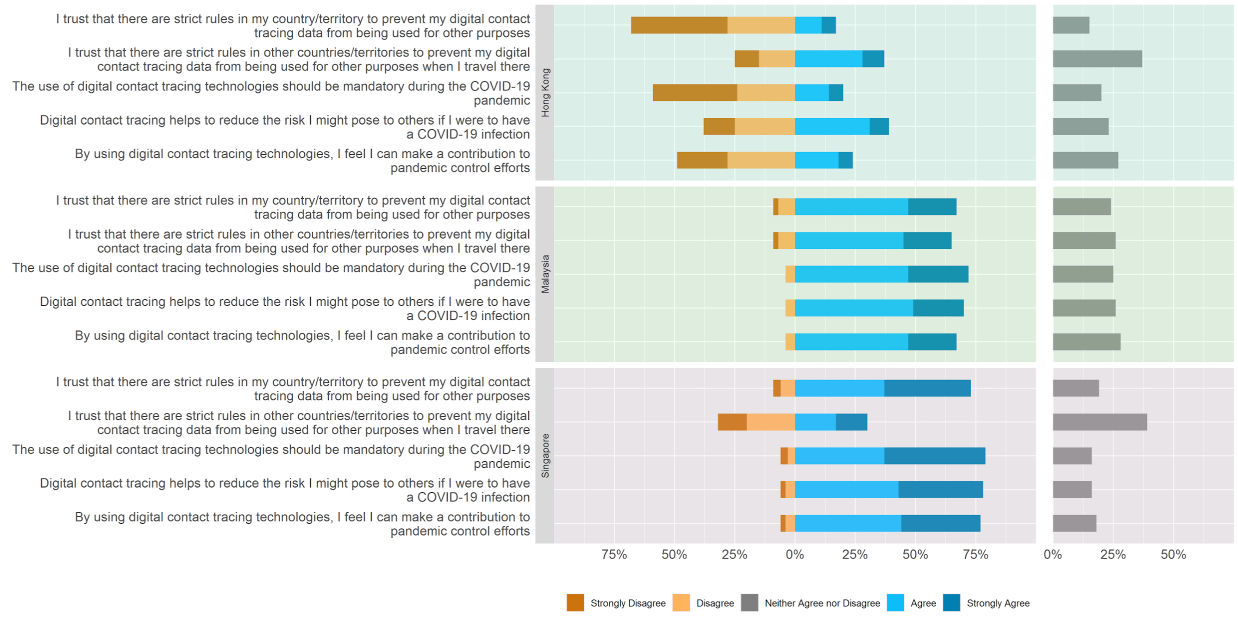
Respondents in Malaysia demonstrated more mixed opinions with respect to digital contact tracing: around two-thirds believed these technologies to be effective at reducing risk of COVID-19 spread and that the benefits outweighed the harms, but more than half of respondents also felt that mandatory use of digital contact tracing was an unreasonable invasion of privacy and restriction of personal freedom.

Figure 3 Digital contact tracing: effectiveness, benefits v. risks, and intrusion into personal freedom and privacy



These differing views were also reflected in differences in the level of trust in how digital contact tracing data would be used in different settings. In Hong Kong, <20% trusted that there were strict rules in place locally to prevent these data being used for other purposes, while a third of respondents trusted that there were such rules in place in other countries. This was the opposite in Singapore, where nearly three-quarters of respondents agreed that there were adequate data protection rules in place locally, but less than a third felt that this was the case in other countries. In Malaysia, two-thirds of the respondents agreed that there were adequate data protection rules in place both locally and in other countries. Similarly, support for mandatory use of digital contact tracing during the pandemic was low in Hong Kong and only a minority agreed that this technology could help reduce the risk they posed to others if they became infected, or that digital contact tracing was a way for them to contribute to pandemic control efforts; more than two-thirds and three-quarters of respondents in Malaysia and Singapore respectively agreed with these statements.

Figure 4 Digital contact tracing: privacy, trust, and mandatory use

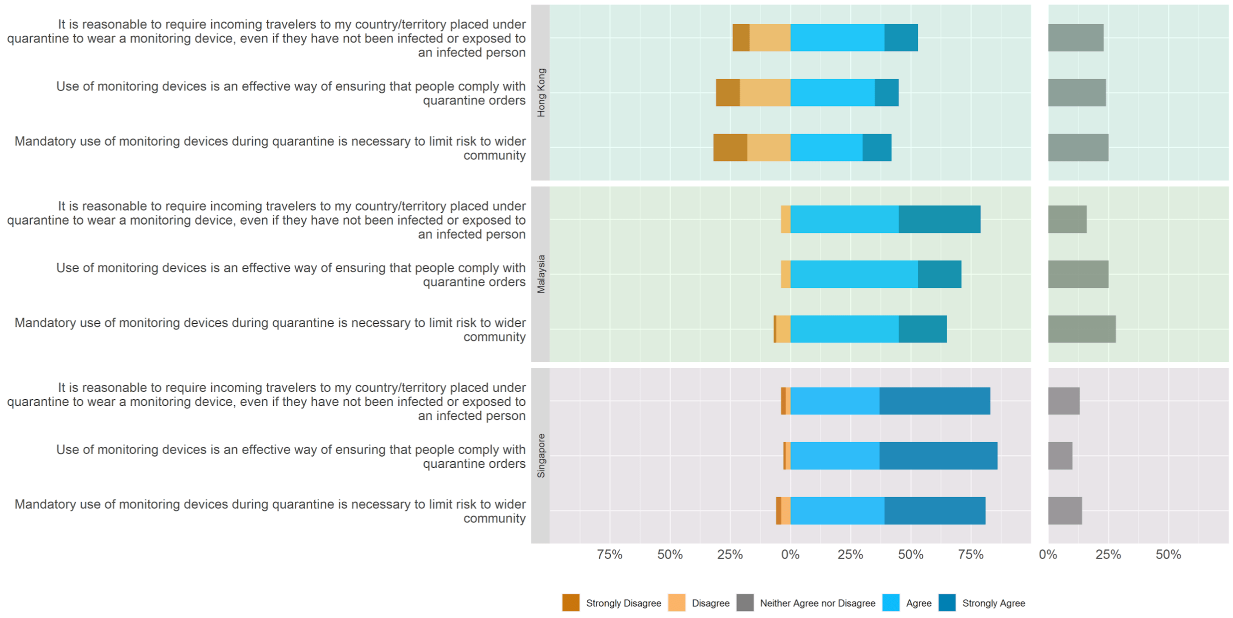


Use of wearable monitoring devices

This pattern of greater public support in Singapore compared with Malaysia and Hong Kong was also observed for wearable monitoring devices. More than 75% of respondents in Singapore felt that it was reasonable to require incoming travelers to wear a monitoring device during quarantine, that monitoring devices were effective in ensuring compliance with quarantine orders, and that mandatory use of these devices was necessary to limit risk to the wider

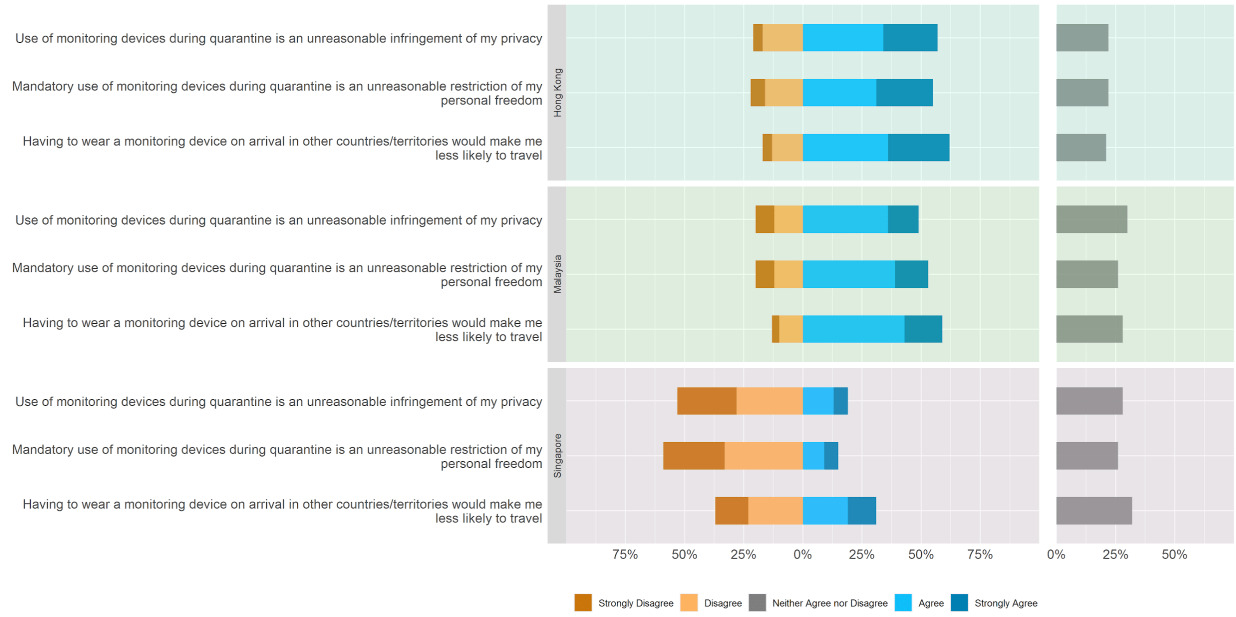
community. The percentage agreeing with these statements was somewhat lower in Malaysia and lowest in Hong Kong, where less than 50% of respondents agreed that use of monitoring devices was effective to ensure compliance with quarantine orders and to limit risk to the wider community.

Figure 5 Quarantine monitoring devices: effectiveness, necessity, reasonableness and mandatory use



Conversely, more than half of respondents in both Hong Kong and Malaysia felt that use of monitoring devices during quarantine was an unreasonable infringement of privacy and restriction of personal freedom, and that having to wear such a device in other countries would make them less likely to travel. Again, Singaporeans appeared to be more comfortable with government surveillance in the form of monitoring individual movement; <20% Singaporean respondents indicated that these strategies were “unreasonable” with respect to privacy or personal freedom.”

Figure 6 Quarantine monitoring devices: intrusion into personal freedom and effects on willingness to travel



Testing for travelers

Requiring COVID-19 testing for travelers regardless of the purpose of travel was generally seen as reasonable, with >75% of respondents in all three settings expressing this opinion. There were differing views between settings in terms of the perceived intrusiveness and who should bear the cost of such testing, however. In Hong Kong and Singapore, around 1 in 8 respondents felt that having to show proof of a negative COVID-19 test before travelling was an unreasonable invasion of privacy, while the corresponding figure in Malaysia was around half of respondents.

In Hong Kong, nearly three-quarters of respondents felt that, for travelers returning from abroad for personal reasons, it was reasonable to require COVID-19 testing at the traveler's expense. In Malaysia and Singapore, around half of respondents felt that it was reasonable to require testing at the government's expense. Having to pay for testing was a substantial disincentive to travel in both Malaysia and Singapore, with over two-thirds of respondents in these two settings stating that it would discourage them from travelling abroad. This figure was around 40% in Hong Kong.

Figure 7 COVID-19 testing: privacy concerns and effects on willingness to travel

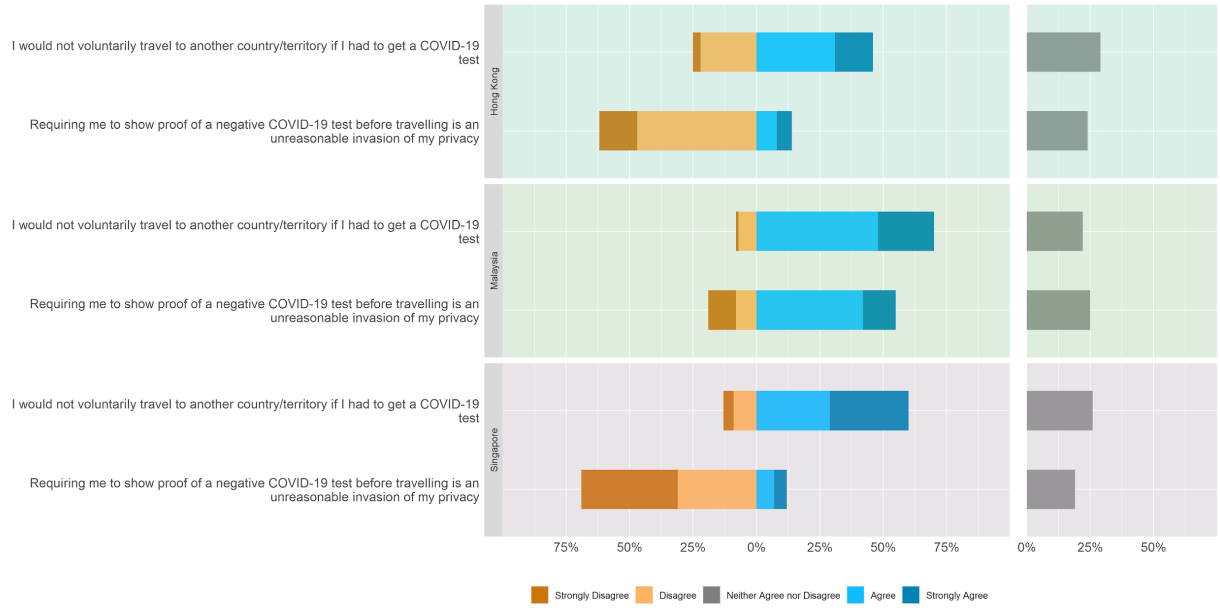
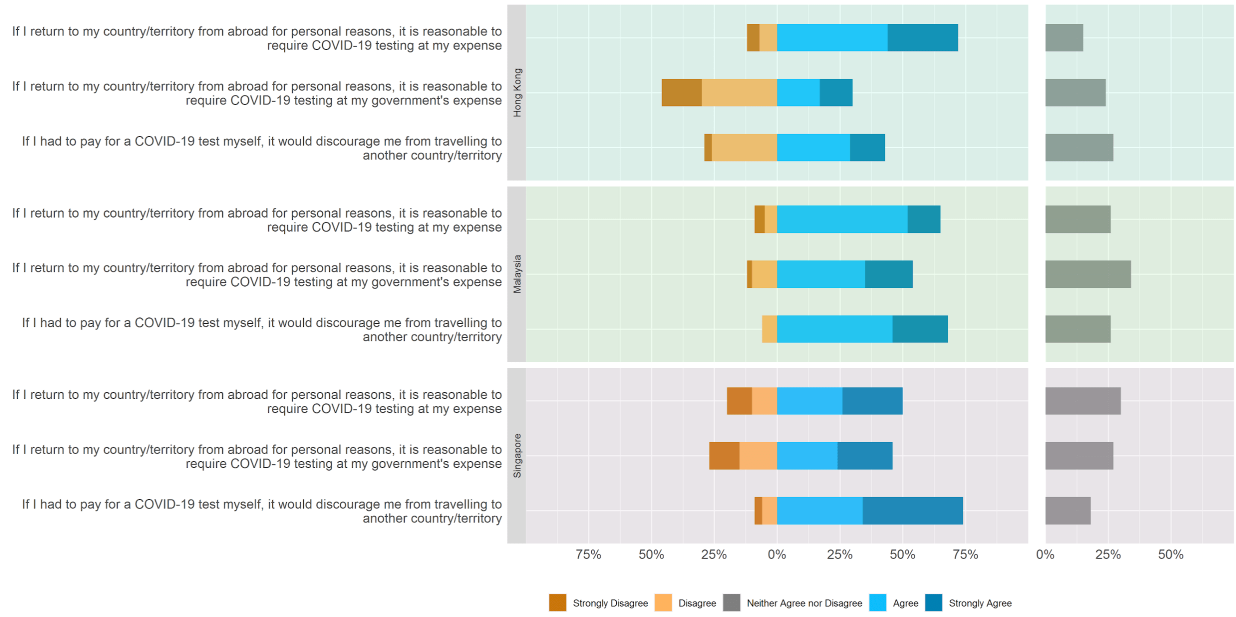
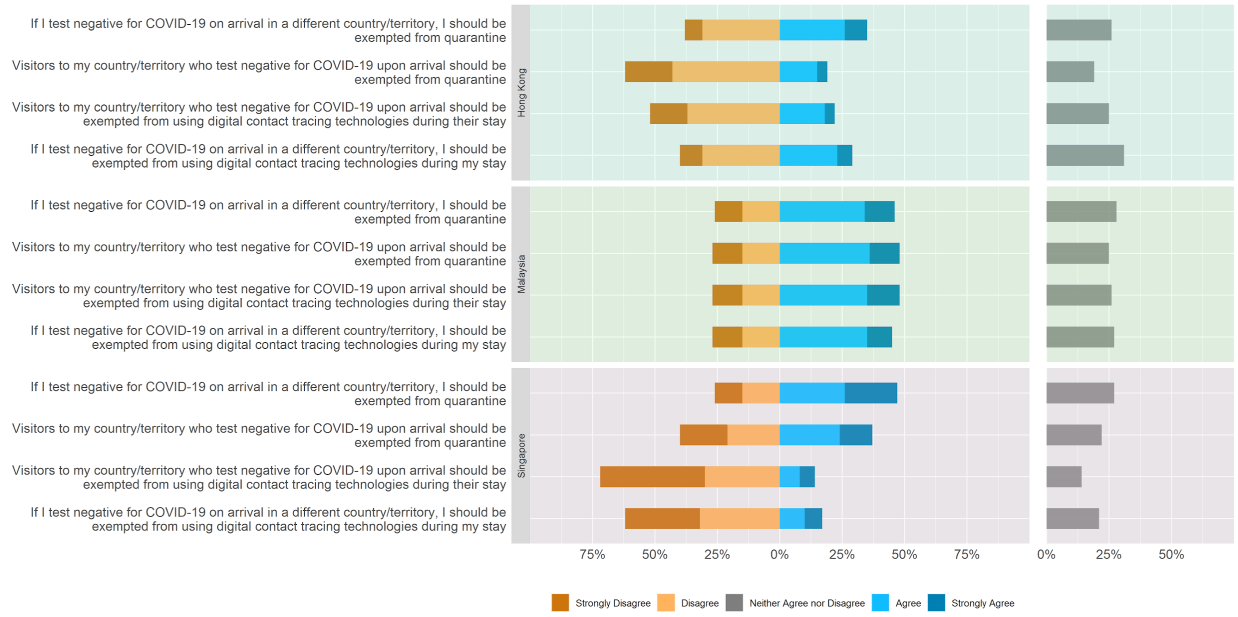


Figure 8 COVID-19 testing: cost burden and effects on willingness to travel



There were also differences between settings in perceptions about what exemptions should be given to travelers who test negative for COVID-19. In Malaysia, nearly 50% of respondents felt that travelers who tested negative should be exempted from quarantine and use of digital contact tracing, whereas in Singapore only a small minority agreed that travelers who tested negative should be exempted from use of digital contact tracing.

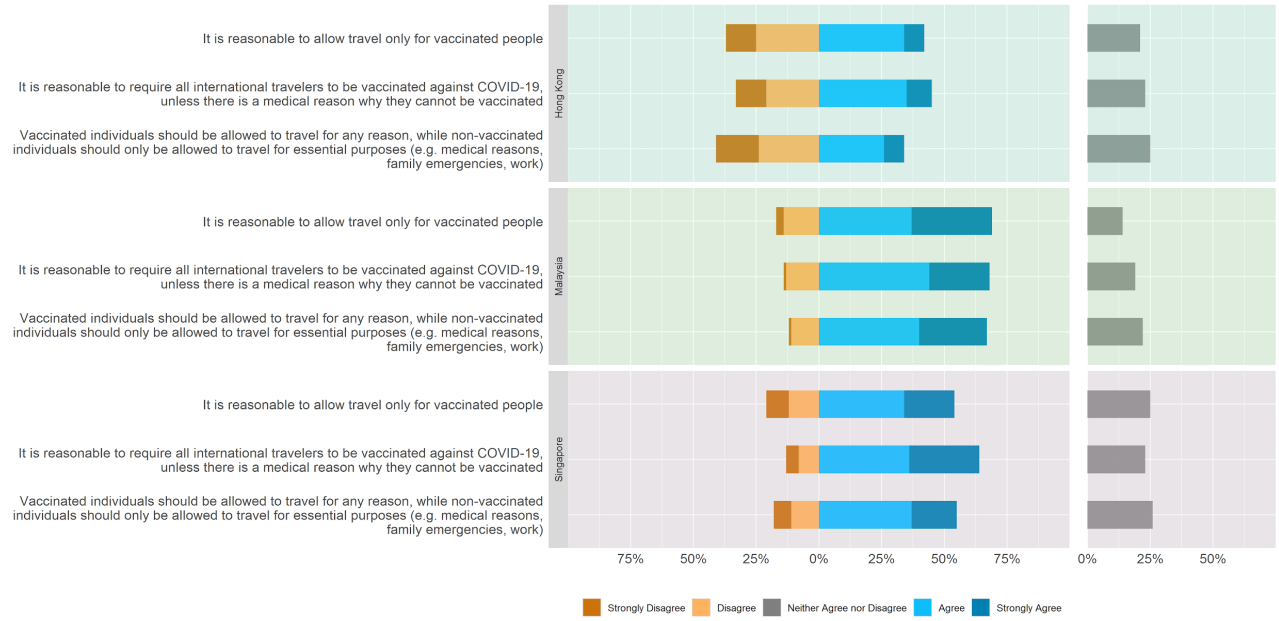
Figure 9 COVID-19 testing: negative tests and related exemptions from restrictive measures



Vaccination for travelers

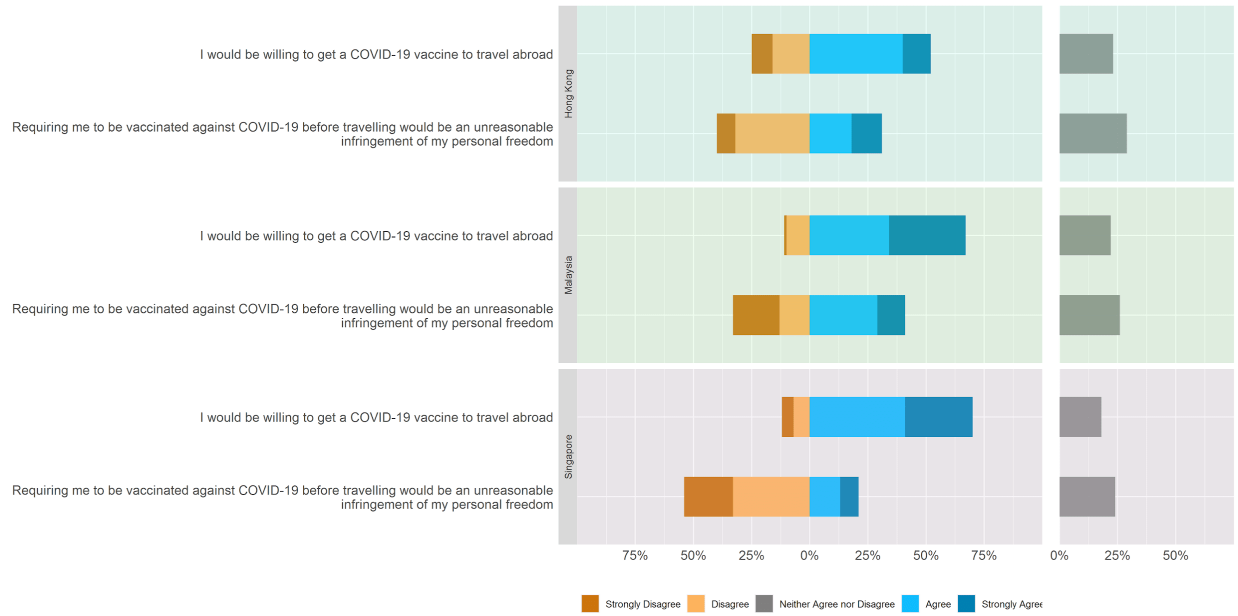
Support for travel-related COVID-19 vaccination was higher in Malaysia than in the other two settings; around two-thirds of respondents in Malaysia agreed that it was reasonable to allow travel only for vaccinated people, that it was reasonable to require all travelers to be vaccinated, and that it was reasonable to allow all travel for vaccinated people, but only essential travel for unvaccinated individuals. These figures were slightly lower in Singapore, while in Hong Kong less than half of respondents agreed with these statements.

Figure 10 COVID-19 vaccination: requirements and restrictions in travel



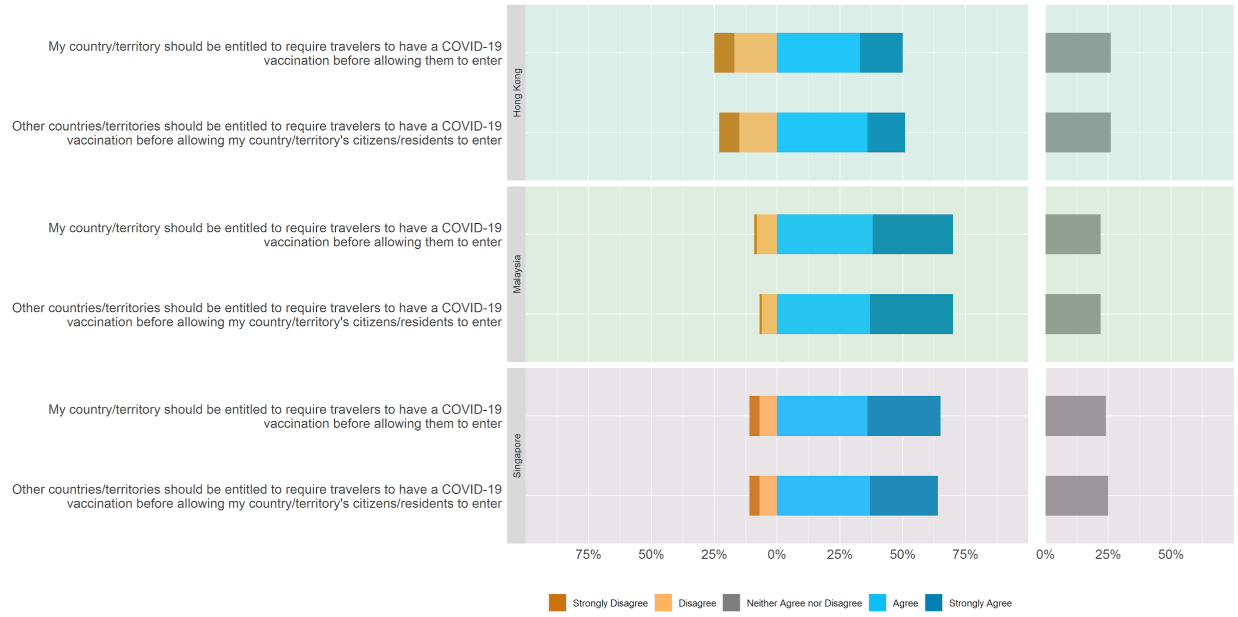
The majority of participants in all three settings did not see COVID-19 vaccination for travel as an unreasonable infringement of personal freedom, and around half of respondents in Hong Kong and two-thirds in Malaysia and Singapore would be willing to get a COVID-19 vaccine to travel abroad.

Figure 11 COVID-19 vaccination: requirement as an infringement of personal freedom and willingness to be vaccinated for travel purpose



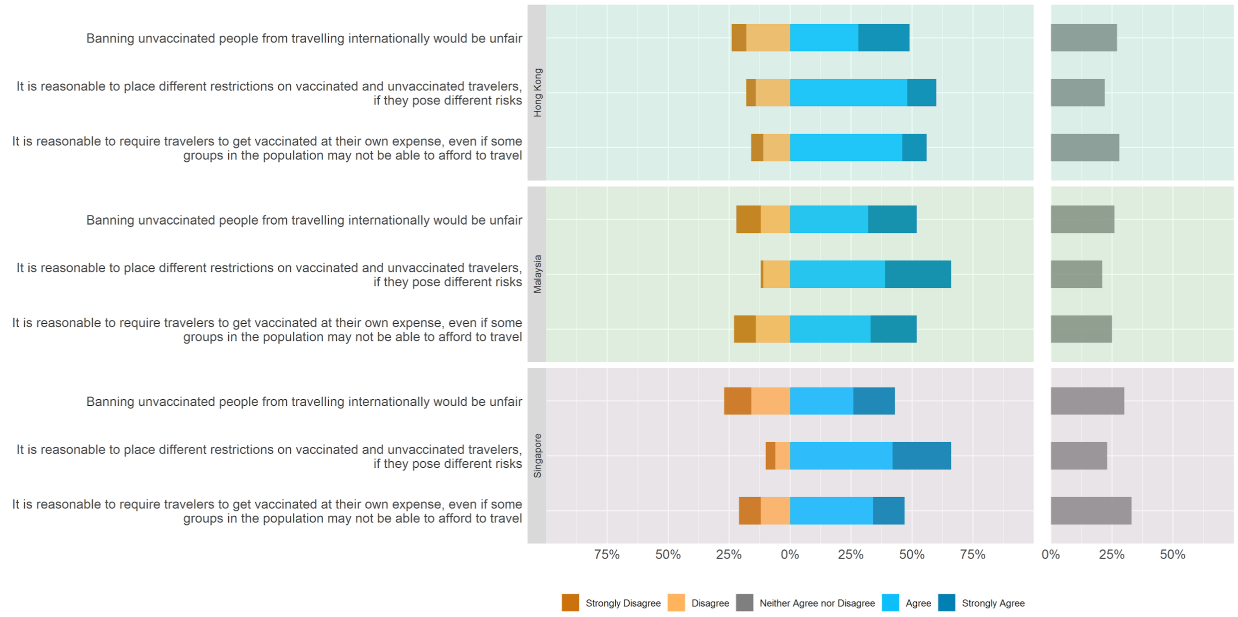
Similarly, around half of respondents in Hong Kong agreed that countries should be entitled to require COVID-19 vaccination for travelers, compared to around two-thirds in Malaysia and Singapore.

Figure 12 COVID-19 vaccination: travel requirement for others to enter one's country/territory v travel requirement for self to enter other countries/territories



Perceptions of equity implications of vaccination policies were mixed. Around a half of respondents in all three settings agreed that banning unvaccinated people from travelling internationally would be unfair. The majority of respondents in all three settings also agreed that it was reasonable to place different restrictions on vaccinated and unvaccinated travelers, and around a half agreed that it was reasonable for travelers to pay for vaccination, even if it meant that some groups in the population may not be able to afford to travel.

Figure 13 COVID-19 vaccination: differential restrictions, and travel bans for unvaccinated people and cost burden



Views on vaccination requirements for travel were not strongly influenced by whether vaccines were widely available or in limited supply (data not shown).

Discussion

Like many countries and territories, Singapore, Malaysia and Hong Kong have adopted multiple strategies to ensure safe movement in community and/or international travel contexts during the global pandemic, including COVID-19 testing, wearable quarantine monitoring devices, and digital contact tracing. The use of digital surveillance, monitoring and certification technologies to ensure safe travel and movement is likely to continue and expand in many countries, at least during the pandemic. This could include COVID-19 vaccination certification to ease or lift movement and travel restrictions. The ethical acceptability of surveillance, monitoring and health certification measures depends on a range of public health and ethical considerations such as effectiveness, necessity, proportionality, equitable distribution of benefits and burdens, and risk minimization.

The success of a public health strategy depends as much on the context as the intervention itself. The ethics of surveillance, monitoring and health certification interventions will be context sensitive, contingent on a country's specific pandemic situation, inequalities, power structures, legal protections, amongst other factors. Our research demonstrates the importance of background political and social conditions in people's perception of public health interventions.

For example, respondents from Hong Kong viewed contact tracing technology as less effective than respondents from Malaysia or Singapore. The effectiveness of the technology used for digital contact tracing in these three settings is unlikely to differ significantly. This difference in perception of effectiveness may instead reflect a broader lack of trust in political institutions and data security in Hong Kong. This is supported by the fact that more than two-thirds of respondents in Hong Kong expressed concern about domestic measures in place to prevent use of contact tracing data for other purposes.

It is therefore important that the ethical merits of public health measures are evaluated, not in the abstract, but in comparison with current or counterfactual strategies and in a given context (Mello & Wang 2020). For example, wearable monitoring devices to ensure compliance with quarantine orders may be perceived as contrary to "the full respect for the dignity, human rights and fundamental freedoms of persons" (Article 3, IHR 2005). Nevertheless, these devices may be more effective in detecting quarantine violations (and thus in mitigating public health risks), and less individually intrusive and burdensome than visits by and daily video calls with public health officers. It may be possible to mitigate concerns about dignity harms, stigma and discomfort from wearable monitoring devices by altering their placement and aesthetic design. A wrist device may feel more like a fitness tracking wearable, whereas an ankle device may feel more like a parole ankle bracelet worn by criminal offenders. Our study shows that most respondents in Singapore, Hong Kong and Malaysia preferred to wear a quarantine monitoring device on the wrist than the ankle (Appendix Table 5). Interestingly, there were more respondents in Malaysia than the other sites who preferred ankle devices or did not think it mattered where the device was worn. Further research could be conducted to understand the reasons for these preferences as well as confounding factors.

Our study indicates that in Singapore, Hong Kong and Malaysia there is high public acceptance of the current and widely used measure of COVID-19 testing to support safe international travel. We found similar acceptance for the potential future use of vaccination for international travel. This finding is consistent with the results of a recent population-based study in Geneva, Switzerland on social and individual perception of vaccination certificates (as well as serology-based immunity certificates), which shows general agreement with the utility of such certificates in specific contexts, including travel and entering countries (Mayssam et al. 2020). About half of the 1425 Swiss respondents agreed that vaccination certification should be mandatory. In our study, about half of Hong Kong respondents and two thirds of Malaysia and Singapore respondents accepted vaccination as a requirement for international travel. Most were supportive of vaccination requirements regardless of whether vaccines are widely available or in limited

supply. That said, a substantial fraction opined that requiring vaccination before travel would be an unreasonable infringement of personal freedom. While the majority of respondents in these settings were willing to be vaccinated once a vaccine becomes available, a substantial fraction was undecided, which may suggest a lack of clarity among the public about how vaccination policies should work. It may also indicate that clear communication about policies and their rationale might be necessary for travel-related vaccination strategies.

Our results also show strong agreement in all three settings with the view that it is reasonable to place different restrictions on vaccinated and unvaccinated travelers. Allowing unvaccinated and vaccinated individuals to travel under different least restrictive conditions (consistent with minimizing public and individual health risks) would be equitable and respects individual freedom of movement (Voo et al. 2020). Our study suggests substantial barriers to travel for many individuals in Singapore and Malaysia, a high income and upper-middle-income country respectively, if they were to bear the financial costs of COVID-19 testing. The same issue may extend to COVID-19 vaccination. Given the recognition that such financial barriers would impact negatively on some sections of the population in terms of freedom of movement, policy-makers could consider subsidizing such costs or capping their price to allow as many individuals as possible to travel, especially if these measures remain or become a requirement for international travel during or after the COVID-19 pandemic.

Respondents from Singapore and Malaysia displayed similarly strong endorsement of monitor devices to ensure compliance with individual quarantine orders. By comparison, respondents from Hong Kong were more likely to think monitoring devices were unreasonable, ineffective and unnecessary. As regards digital contact tracing, Singapore and Malaysia respondents expressed similar levels of confidence in their effectiveness, and both groups strongly endorsed the view that the benefits of such technology outweigh the risks. However, Singapore respondents expressed significantly stronger support of mandatory use of digital contact tracing technology than Malaysian respondents. This may be a reflection of a society that is accustomed to the use of legislation and mandates to shape behaviors and enforce compliance with public health measures; electronic tags were also applied to monitor individuals quarantine in Singapore during the 2002-2003 Severe Acute Respiratory Syndrome (SARS) epidemic (Ooi, Lim & Chew 2005). As for Hong Kong, most respondents did not think that digital contact tracing was effective and more strongly objected to mandatory use of digital contact tracing and monitoring devices for incoming travelers. Interestingly, they were more comfortable with the use of home monitoring devices for people serving quarantine notices at home or in a hotel. This may indicate

that in Hong Kong, the public's concern is primarily with the prospect of government tracking of movement in the community and public spaces.

Differences between respondents in Singapore, Malaysia and Hong Kong, particularly with respect to government surveillance and individual monitoring may indicate different degrees of background trust in these different settings. Trust is a fundamental element of social capital, especially in the context of a public health emergency. Trust depends on the trustor's assessment of the trustee's competence and intent and can apply on multiple levels—interpersonal, with respect to political or legal systems, and/or specific agencies such as the health service or police. Recent political instability and tension in Hong Kong have likely been a strong influence in our data. Prior research has found a positive correlation between low violence and high political stability and reported high level of interpersonal trust (World Development Report 2013). Interpersonal trust is a measure of social cohesion and is strongly correlated to countries' capacity to engage in peaceful collective decision making.

The 2019 Edelman Trust Barometer demonstrates the following percentages of trust in government ("do you trust the government to do what is right?") in each of the settings surveyed: Singapore 67%, Malaysia 60% and Hong Kong 55%. Trust in government is an important determinant of citizens' compliance with public health policies. Research during the 2014-2015 Ebola epidemic in Liberia found that people who distrusted their government took fewer precautions against Ebola and were also less compliant with Ebola control policies (Blair, Morse & Tsai 2017).

Ethical acceptability of these technologies in a given setting may also depend on exposure and actual experience over time regarding their public and individual benefits and trade-offs between enabling the easing of movement and assembly restrictions and concerns such as privacy intrusion. Transparent and consistent public health communication on implementation details such as data minimization and protection, and high trust in government and governmental COVID-19 strategies are also critical to public acceptability. Plausibly, the combination of these factors may explain why there is greater public support in Singapore for digital contact tracing (including for travelers who test negative for COVID-19) and quarantine monitoring compared to Hong Kong and Malaysia.

A recommended intervention to promote public trust and acceptance for digital surveillance and monitoring is to implement an independent ethics oversight mechanism (WHO 2020; Nuffield Council on Bioethics 2020) but it is unclear how effective this approach would be in settings with tense political climates and reduced governmental trust (such as Hong Kong at time of

writing). Much may depend on how impartial and independent this mechanism is regarded to be by the public.

Based on the study and its insights, we propose the following recommendations:

- Our research found significant difference in public perception on ethical dimensions of surveillance, monitoring and health certification measures for international travel during the COVID-19 pandemic between these three Asian neighbors. Effective public health strategies need to be targeted to the particular context. Countries should, where possible, conduct local research to better understand and respond to specific local concerns, rather than rely on qualitative research from other countries or pre-pandemic.
- Transparency and openness are essential to public trust in government and successful public health interventions. Transparency should apply to sharing bio-medical and public health information about COVID infections rates, clusters and data concerning vaccine safety, efficacy and adverse events. But transparency should also apply to government decision making processes so that the public can see these are trustworthy, representative and reasonable. It is important the public understands why and how decisions about surveillance, monitoring and health certification in the context of international travel have been made, including how specific trade-offs have been managed.
- Social inequality is correlated to decreased public trust. Governments should consider the equity implications for different COVID-19 policies and where possible avoid, mitigate or compensate for any newly generated inequalities or vulnerabilities arising from public health strategies. For example, if vaccination is required for international travel this could disadvantage people who, for medical reasons, are advised not to be vaccinated.
- International cooperation and coordination will be essential to establish common standards and integrated approaches to vaccination certification for travel. Our research shows high public acceptance for the use of vaccination as a requirement for international travel, and agreement with different restrictions on vaccinated and non-vaccinated travelers. Nevertheless, a substantial fraction felt that requiring COVID-19 vaccination for travel would be an unreasonable infringement of personal freedom. Ethical governance of COVID-19 vaccination certificates for travel purposes should protect not just the right to obtain and hold a vaccination certificate (WHO 2020a) but also the right to travel without one.

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Appendix

Table 0.1

Breakdown of each Sample, by Location of Vaccine Sentiment Questions in Survey

Origin	Groups	N	%
Hong Kong	Vaccine Sentiment Questions at Start of Survey	322	48
	Vaccine Sentiment Questions at End of Survey	347	52
Malaysia	Vaccine Sentiment Questions at Start of Survey	975	50
	Vaccine Sentiment Questions at End of Survey	981	50
Singapore	Vaccine Sentiment Questions at Start of Survey	479	49
	Vaccine Sentiment Questions at End of Survey	503	51

Table 0.2

Breakdown of each Sample, by Vaccine Scenario

Origin	Groups	N	%

Hong Kong	Limited Vaccine Scenario	336	50
	Widely Available Vaccine Scenario	333	50
Malaysia	Limited Vaccine Scenario	995	51
	Widely Available Vaccine Scenario	961	49
Singapore	Limited Vaccine Scenario	491	50
	Widely Available Vaccine Scenario	491	50

Table 1

Comparison of Demographic Breakdown of Singapore Sample with Census 2010

		Sample		**Census**
Variable	**Groups**	**N (982)**	**%**	**%**
Age Group	20 - 29	178	18.1	18.2
	30 - 39	206	21.0	21.7

	40 - 49	229	23.3	22.2
	50 - 59	181	18.4	19.3
	60 - 69	153	15.6	10.6
	70+	35	3.6	8.0
Gender	Female	611	62.2	50.7
	Male	371	37.8	49.3
Ethnicity	Chinese	821	83.6	74.1
	Malay	46	4.7	13.4
	Indian	91	9.3	9.2
	Others	24	2.4	3.3
Marital Status	Married	571	58.6	59.4
	Single	336	34.5	32.2
	Divorced/Separated	55	5.6	3.3
	Widowed	12	1.2	5.1
Education Level	Below Secondary	12	1.2	32.4

	Secondary	160	16.4	18.9
	Post-Secondary, Non-University	338	34.6	25.9
	University	468	47.9	22.8
Monthly Household Income	Less than $2000	143	16.0	11.8
	$2000 to $3999	179	20.1	18.4
	$4000 to $5999	175	19.6	17.1
	$6000 to $10000	248	27.8	24.2
	More than $10 000	147	16.5	28.5
Housing	1 to 2-room HDB	29	3.0	4.6
	3 - room HDB	201	20.6	20.1
	4 - room HDB	370	37.9	32.0
	5 - room HDB/executive flat	269	27.6	25.7
	Condominium	65	6.7	11.5
	Landed house	32	3.3	5.7

	Others	9	0.9	0.5

Table 2
Comparison of Demographic Breakdown of Malaysia Sample with Census 2010

		Sample		**Census**
Variable	**Groups**	**N (1956)**	**%**	**%**
Age Group	20 - 29	489	25.0	29.8
	30 - 39	889	45.4	22.2
	40 - 49	493	25.2	19.6
	50 - 59	73	3.7	14.6
	60 - 69	12	0.6	8.3
	70+		NA	5.4
Gender	Female	1080	55.3	49.3
	Male	873	44.7	50.7
Ethnicity	Chinese	982	50.3	24.5
	Malay	637	32.6	67.3

	Indian	331	17.0	7.3
	Others	2	0.1	0.9
Marital Status	Married	886	46.8	59.6
	Single	891	47.1	35.1
	Divorced/Separated	84	4.4	0.8
	Widowed	31	1.6	4.5
Education Level	Primary	8	0.4	17.5
	Junior secondary	102	5.4	14.8
	Senior secondary	807	42.8	41.5
	Tertiary, non-degree	664	35.2	16.5
	Tertiary, degree	303	16.1	9.7
Monthly Household Income*	< RM4850	823	48.1	40.0
	RM4850 - 10959	715	41.8	40.0
	> RM 10959	172	10.1	20.0
Housing	Flat/Apartment	475	29.5	16.0

	Condominium/SOHO	591	36.7	4.5
	Terrace/Townhouse	462	28.7	35.4
	Semi-detached (Semi-D)	67	4.2	7.1
	Bungalow/Penthouse	13	0.8	34.4
	Others	2	0.1	2.5

* Household Income & Basic Amenities Survey 2019 data was used for the "Census"

Table 3
Comparison of Demographic Breakdown of Hong Kong Sample with Census 2016

		Sample		**Census**
Variable	**Groups**	**N (669)**	**%**	**%**
Age Group	20 - 29	81	12.1	15.5
	30 - 39	134	20.0	18.6
	40 - 49	129	19.3	18.4
	50 - 59	177	26.5	20.5
	60 - 69	116	17.3	14.5

	70+	32	4.8	12.4
Gender	Female	240	36.1	54.0
	Male	424	63.9	46.0
Ethnicity	Chinese	614	92.1	92.0
	Indian		NA	0.5
	Others	53	7.9	7.5
Marital Status	Married	372	58.2	51.8
	Never married	212	33.2	38.0
	Divorced	36	5.6	4.1
	Separated	7	1.1	0.4
	Widowed	12	1.9	5.7
Education Level	No formal qualifications/lower primary		NA	12.0
	Primary	2	0.3	13.7
	Junior secondary	25	3.8	17.6

	Senior secondary	125	19.1	26.1
	Tertiary, non-degree	103	15.7	9.9
	Tertiary, degree	400	61.1	20.7
Monthly Household Income	Less than $10 000	35	6.3	19.1
	$10 000 to $19 999	63	11.3	21.8
	$20 000 to $29 999	83	14.8	15.8
	$30 000 or more	378	67.6	43.2
Housing	Public housing	239	38.7	29.1
	Private housing	365	59.2	53.2
	Others	13	2.1	17.8

Table 4

Frequency and percentage of respondents willing to get vaccinated against COVID-19, for various variable subgroups, and for each survey setting

Variable	**Groups**	**Singapore**	**Malaysia**	**Hong Kong**

Vaccine Confidence	1 - 2	0 (0.0%)	1 (4.5%)	1 (5.3%)
	> 2, up to 3	4 (17.4%)	0 (0.0%)	4 (14.3%)
	> 3, up to 4	48 (30.2%)	44 (34.1%)	68 (41.2%)
	> 4, up to 5	192 (80.3%)	229 (63.4%)	147 (82.6%)
Worry	Strongly Disagree	28 (34.1%)	3 (50.0%)	5 (29.4%)
	Disagree	80 (56.7%)	36 (24.5%)	34 (48.6%)
	Neither Agree nor Disagree	134 (49.3%)	224 (45.6%)	106 (54.1%)
	Agree	197 (71.9%)	366 (46.0%)	196 (60.7%)
	Strongly Agree	174 (81.7%)	455 (88.2%)	41 (68.3%)
Self-Efficacy	Strongly Disagree	14 (50.0%)	94 (88.7%)	10 (38.5%)
	Disagree	30 (43.5%)	97 (42.7%)	64 (54.2%)
	Neither Agree nor Disagree	175 (53.7%)	305 (50.9%)	161 (56.1%)
	Agree	274 (70.8%)	367 (50.3%)	129 (61.4%)
	Strongly Agree	120 (69.8%)	221 (74.9%)	18 (72.0%)
Age Group	21-30 years	144 (72.7%)	391 (62.9%)	54 (58.1%)

	31-40 years	141 (65.9%)	473 (55.5%)	82 (58.6%)
	41-50 years	143 (65.9%)	188 (45.1%)	79 (60.8%)
	51-60 years	100 (52.6%)	28 (50.9%)	87 (51.2%)
	61-70 years	77 (55.4%)	4 (44.4%)	62 (55.9%)
	71+ years	8 (33.3%)	NA	18 (75.0%)
Gender	Female	352 (57.6%)	631 (58.4%)	107 (44.6%)
	Male	261 (70.4%)	451 (51.7%)	271 (64.1%)
	Non-binary	NA	1 (50.0%)	3 (100.0%)
	Refuse to answer	NA	NA	1 (50.0%)
Education Level	No formal qualifications/lower primary	0 (0.0%)	13 (59.1%)	NA
	Primary	6 (60.0%)	4 (50.0%)	2 (100.0%)
	At least some secondary education	93 (58.1%)	510 (56.1%)	80 (53.7%)
	Tertiary, non-degree	202 (59.8%)	375 (56.5%)	56 (54.4%)
	Tertiary, degree	310 (66.2%)	154 (50.8%)	239 (59.8%)
	Refuse to answer	2 (50.0%)	24 (61.5%)	5 (35.7%)

Housing	Flat/Apartment	547 (62.9%)	279 (58.7%)	138 (57.7%)
	Private housing estates	35 (53.8%)	295 (49.9%)	204 (57.3%)
	Landed house	21 (65.6%)	294 (54.2%)	6 (75.0%)
	Others	6 (66.7%)	0 (0.0%)	8 (61.5%)
	Do not know	1 (50.0%)	96 (63.2%)	1 (25.0%)
	Refuse to answer	3 (60.0%)	118 (61.8%)	25 (52.1%)

Table 5