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Factors associated with the opposition to COVID-19 vaccination certificates: A multi-country observational study from Asia

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1. Introduction

The coronavirus or SARS-CoV-2 (COVID-19) pandemic has disrupted all aspects and sectors of society [1]. The mass rollout of COVID-19 vaccines has reduced the strain on health systems by reducing the severity of disease [2], thereby permitting economies to slowly recover through progressive resumption of normal socioeconomic activities. The latter has been facilitated in many countries by the issuance of

government-backed COVID-19 vaccination certificates (CVCs), which easily identify persons who are deemed to pose less threat to health systems, by virtue of being vaccinated [3]. In addition to CVCs, immunity certificates which are a proof of immunity from past COVID-19 infection or antibody tests are also being used for the same purpose [4]. Countries such as Israel, U.K., Canada, and Thailand have been implementing CVCs nationally, while the European Union (EU) and African Union (AU) are doing so at the regional level [5]. Despite the

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widespread use of CVCs and similar certificates, WHO has refrained from defining scenarios under which they can be used, leaving it to the discretion of member states [6]. Therefore, CVCs are being pursued without global consensus or common policy. While there are ongoing calls to harmonise initiatives and establish a regional CVCs for Asia [7, 8], such efforts have not been realised.

It is apparent by now that COVID-19 cannot be eliminated, and therefore use of CVCs will remain for the foreseeable future [9]. However, global or regional adoption of CVCs is plagued by challenges such as mistrust in governments, implementation hurdles, and the lack of common policy [4,10,11]. Further, vaccine inequity particularly in low-and middle-income countries (LMICs) [12] and vaccine hesitancy may hinder vaccination and therefore, wider adoption of CVCs. While it can be argued that achieving population level vaccine coverage could render CVCs redundant, clinical uncertainties such as waning protection and continued emergence of new variants [9] mean the need for proof of boosters or yearly vaccinations are already being discussed. As countries continue to use CVCs to reopen their economies, it is essential that such policies are informed by scientific evidence [13] and publicly accepted for it to maximise benefits and minimise challenges. Hence, the question of who opposes the adoption of CVCs (analogous to which groups are vaccine hesitant [14]) may have more policy relevance. Existing studies exploring public perception of CVCs have found mixed opinions [15–20]. However, the majority of these studies have been western-centric, and their findings may not be generalisable to Asia given contextual differences such as vaccination rates, trust in government, tolerance for and adherence to restrictive COVID-19 policies, dependency on tourism among others [12,21,22]. A cross-sectional survey in China found widespread support for CVCs, possibly linked to adherence to national policy, but factors associated with opposition to CVCs were not explored in detail [23]. Identifying groups in Asian societies who are opposed to CVCs and understanding their reasons are necessary steps towards addressing public concerns and harmonising an effective CVCs policy in the region. However, such formal studies are currently lacking.

The COVID-19 Vaccination Policy Research and Decision-Support Initiative in Asia (CORESIA) is a project commissioned by the Thai government in 2021 to understand and address COVID-19 vaccine-related policy questions in Asia, including on CVCs [5]. The CORESIA team comprises a mix of government and research institutions from nine countries in Asia including India, Indonesia, Japan, Laos, Malaysia, the Philippines, Singapore, South Korea, and Thailand. The team is advised by a group of global inter-disciplinary experts, policymakers, and WHO representatives from the Asian region. To understand acceptability and implementation considerations for CVCs, a regional public survey (n = 12,547) was conducted in all nine countries while an institutional (public and private organisations from health and non-health sectors) survey (n = 795) was conducted in India, Laos, the Philippines, Singapore, and Thailand. Constrained by COVID-19 pandemic control efforts, organisations from other Asian countries were unable to participate in this initiative. The results from these surveys have informed policymaking in countries such as Thailand [24,25]. We present here the results and analyses from the public survey to understand who and why do people in Asia oppose the adoption of CVCs. We also discuss how these reasons may be addressed to improve wider acceptance. The scope of this study is limited to CVCs alone and excludes immunity certificates.

2. Method

2.1. Study design

An online self-administered cross-sectional survey was conducted from June to October 2021 across nine Asian countries including India, Indonesia, Japan, Laos, Malaysia, the Philippines, Singapore, South Korea, and Thailand. The questionnaire was first developed in English

by (i) reviewing literature on vaccination certificates [4,10,15] and (ii) consulting with CORESIA members. The questionnaire was piloted with representatives of Thai stakeholder institutions (including the Ministry of Finance, civil rights groups, the tourism board, and immigration bureau among others) and among CORESIA members to improve clarity and comprehensibility. The questionnaire was later translated into Bahasa Indonesia, Malay, Japanese, Lao, Korean, and Thai for wider reach. A total of 39 questions were included in the survey, and the full English version is available in Supplementary 1.

2.2. Participants and recruitment

Individuals aged 18 years and above from the nine countries in Asia were eligible to participate in the survey. Approval was granted by the relevant ethics review boards in the countries requiring it to conduct this study. Informed consent was obtained prior to participating in the voluntary survey. Data were treated with strict confidentiality and only aggregated results are reported.

The online survey was disseminated through member organisations' network including emails, websites, and social media such as Twitter, Facebook, LinkedIn. India, Japan, and South Korea fielded the surveys nationwide through private survey agencies, hence, data from these countries may be considered to be nationally representative. In addition to these channels, face-to-face interviews were conducted in Laos (only in Vientiane) and survey linked shared across the country via WhatsApp to reach individuals without access to computers. Given the difference in approaches taken to field the survey across countries, no sample size calculation was done but rather snowball sampling method was employed to maximise the number of participants. Finally, the surveys were made available on the CORESIA website (www.vaxcert.info) which is a public repository of regularly updated CVC related policies (globally), research, and news, targeted at general public, academics, and policymakers for information and collaboration.

2.3. Variables

The full questionnaire had five sections: (i) participant information; (ii) purpose of CVCs; (iii) COVID-19 interventions and policies; (iv) implementation of CVCs; and (v) concluding position on adoption of CVCs. Only eleven questions from the survey are relevant to the stated objective of understanding who and why people in Asia might oppose the adoption of CVCs, which include:

2.3.1. Opposition to CVCs

The dependent variable, opposition to CVCs was determined with this question: considering all factors (public health, economic situations, ethics and social justice, privacy, and resource requirements), should CVCs be adopted in their countries (yes, no, unsure). Responses were transformed to binary outcomes (1 if response = no or unsure, and 0 if response = yes). Responses of 'unsure' were combined with 'no' as we assumed those unsure would be more inclined to oppose CVCs.

2.3.2. Sociodemographic factors

A previous study found that sociodemographic factors could be associated with public attitude towards CVCs [17]. Hence gender and education variables were included in the analysis. Further, the countries of the respondents were included to account for differences in sample size. Following the WHO recommendation, most countries prioritised their stock of COVID-19 vaccines based on age (elderly) and occupation (healthcare workers) [26]. Hence, age and occupation, although potentially important predictors of opposition to CVCs, were excluded from analysis to avoid multicollinearity in the model as they could explain the variables on status of vaccination, which was one of the control variables used in the model.

Responses of 'prefer not to say' were treated as missing data together with 'no response' for all variables and removed from analyses.

2.3.3. COVID-19 vaccination status

2.3.3.1. Vaccination status 1. People who had not received a dose of any COVID-19 vaccine are likely to oppose CVCs resulting from either a negative attitude towards the vaccines [17] or because they are likely to be excluded from benefiting from the freedom of movement that CVCs offer [18]. Hence, the analyses included the variable, *vaccination status 1* (1st dose, 2nd or full dose, none, prefer not to say). Responses were re-categorised to binary outcomes (vaccinated, unvaccinated), where ‘vaccinated’ included both 1st and 2nd or full dose of vaccination and ‘unvaccinated’ included those who said “none”. We assumed those who had received their first dose would have completed their full doses and their attitude towards CVCs would have remained unchanged.

2.3.3.2. Vaccination status 2. Among the unvaccinated, we postulated that their reasons for remaining unvaccinated may further explain their attitude towards CVCs because the views of those waiting to be vaccinated may differ from those who are vaccine hesitant. To examine this difference, we created a second variable, *vaccination status 2*, which included their reasons for not being vaccinated in our analysis. This was done by keeping the vaccinated responses from the variable, *COVID-19 vaccination status 1*, but replacing the unvaccinated responses with their corresponding reasons for not getting vaccinated. Hence, this variable offered seven possible responses: vaccinated; registered and awaiting 1st dose; still considering getting vaccinated; no intention of getting vaccinated; vaccine not available in the country; not in priority group; and want a different brand of vaccine.

2.3.4. Travel plans in 2021

Studies have found a correlation between a favourable attitude towards CVCs and the desire to travel [11,20]. Hence, by including a variable on travel plans in 2021, we hypothesised that people who had no travel plans in 2021 would be more likely to oppose CVCs as they are less likely to have utility and benefit from having it.

2.3.5. Continuing existing non-pharmaceutical interventions (NPIs)

Both NPIs and CVCs have been viewed as restrictive policies that violate human rights [11]. Hence, we included a variable on whether existing NPIs (such as social distancing, mask wearing, testing, quarantine) should continue in their own country and hypothesised that people opposing existing NPIs are also more likely to oppose CVCs as they prohibit freedom of movement for the unvaccinated.

2.3.6. Public trust in government

Public trust in government is associated with compliance to policies, especially during the COVID-19 pandemic [27]. A higher level of trust is also associated with acceptance of CVCs [19]. Hence, the analysis included a variable measuring public trust in government (high, moderate, low).

2.3.7. Perceived financial benefits from CVCs

The perception of receiving personal benefits among the public has been identified as a significant predictor of positive attitudes towards CVCs [23]. Hence, we added a variable on whether CVCs is likely to bring financial benefits to participants occupational sector and postulated that those perceiving no financial benefits would be more likely to oppose CVCs.

2.3.8. Purpose of CVCs

CVCs are being used for several purposes including employment, entry into events, travel, etc [5]. Previous studies have found support for CVCs to ease foreign travel [11,20] as well as for maintaining safe work environments [17]. Hence, we included the scenarios under which CVCs are used (i.e., purpose of CVCs) to assess if they affect people’s attitudes towards CVCs.

2.4. Data analysis

Descriptive analysis was conducted to provide a general profile of the survey’s responders. All variables were categorical and reported as absolute (numbers) and relative (percentage) frequencies.

A multivariable logistic regression was performed to identify factors associated with opposition to CVCs in Asia by reporting the odd ratios (ORs). Two separate regression models were employed to explore this. In both models, the outcome variable was opposition to CVCs (yes, no) and explanatory variables included those listed under variables section. The key distinction between the two models was the choice of the one of the explanatory variables, ‘COVID-19 status of vaccination’. Model 1 used the variable, *vaccination status 1* (vaccinated, unvaccinated), while model 2 used the variable, *vaccination status 2*. Model 2 aimed to identify those among the unvaccinated group most likely to oppose CVCs. Both models were run individually for all nine countries as well as for two groups of countries who were regrouped into those with more than 1000 responses (India, the Philippines, Thailand) and less than 1000 responses (remaining six countries) to explore the effects of varying sample size. The assumption that those who had received their 1st dose would have completed their full course and their attitude towards CVCs would have remained unchanged was tested through a sensitivity analysis by counting those who only received their 1st dose as unvaccinated for model 1. Regression diagnostic tests were conducted including multicollinearity and homoscedasticity, and robust standard errors were used. Data from all countries were combined and analysed using Stata (Release 16-0 Stata Corp, College Station, TX, USA) with a statistically significant level ($p < 0.05$).

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3. Results

A total of 12,547 responses were received. There were 4,833 observations with one or more missing answers (including those responded with ‘prefer not to say’), leaving a total of 7,714 (61%) responses for the logistical regression analyses. Descriptive summary is provided in [Table 1](#).

3.1. Descriptive summary

Majority of survey respondents (87%) accepted the adoption of CVCs while 13% opposed it. The majority of respondents were male (51%), had an undergraduate degree (57%), and were from the Philippines (30%). The majority had had been vaccinated (89%), i.e., received either one or full course of vaccination. Of the 11% who were unvaccinated, 5% had registered and were waiting for their first dose, 2% were still considering getting vaccinated, 1% had no intention of getting vaccinated, 2% were not yet in the vaccine priority group, 1% wanted a different brand of vaccine and the remaining said vaccines were not yet available in their country. Only 27% of the respondents said they had travel plans in 2021 and majority (50%) anticipated financial benefits to their occupation sector from adopting CVCs. The majority (85%) wanted existing NPIs to continue and 43% of respondents placed a high level of trust in their governments. Highest agreement on the purpose of CVCs was seen for easing foreign travel (80%) and lowest for resuming in-person employment (60%). Detailed description of participant’s characteristics and their responses to acceptance of CVCs are presented in

Table 1
Characteristics of study population and their response to adoption of CVCs.

Variables	Regional Total, N (%)	Respond to adoption CVCs, N (%)	
	N = 7714 (100)	Yes, 6717 (87)	No, 997 (13)
Gender			
Female	3751 (49)	3327 (89)	424 (11)
Male	3923 (51)	3355 (86)	568 (14)
Other	40 (1)	35 (88)	5 (13)
Education			
No formal schooling	8 (0)	8 (100)	0 (0)
High school or lower	819 (11)	660 (81)	159 (19)
Undergraduate	4404 (57)	3841 (87)	563 (13)
Postgraduate or higher	2483 (32)	2208 (89)	275 (11)
Country			
India	2002 (26)	1627 (81)	375 (19)
Indonesia	396 (5)	349 (88)	47 (12)
Japan	628 (8)	500 (80)	128 (20)
Laos	199 (3)	188 (94)	11 (6)
Malaysia	181 (2)	168 (93)	13 (7)
The Philippines	2291 (30)	2072 (90)	219 (10)
Singapore	163 (2)	150 (92)	13 (8)
South Korea	520 (7)	436 (84)	84 (16)
Thailand	1334 (17)	1227 (92)	107 (8)
Vaccination status 1			
Vaccinated	6833 (89)	6059 (89)	774 (11)
Unvaccinated	881 (11)	658 (75)	223 (25)
Vaccination status 2			
Vaccinated	6833 (89)	6059 (89)	774 (11)
Awaiting my first dose	414 (5)	348 (84)	66 (16)
Considering	148 (2)	86 (58)	62 (42)
No intention	66 (1)	25 (38)	41 (62)
Not available in my country	29 (0)	20 (69)	9 (31)
Not in priority group	136 (2)	111 (82)	25 (18)
Want a different brand	88 (1)	68 (77)	20 (23)
Travel plans in 2021			
Yes	2085 (27)	1898 (91)	187 (9)
No	5629 (73)	4819 (86)	810 (14)
Financial benefit from CVCs			
Yes	3853 (50)	3607 (94)	246 (6)
No	3407 (44)	2708 (79)	699 (21)
Unemployed	454 (6)	402 (89)	52 (11)
Continue NPIs			
Yes	6565 (85)	5896 (90)	669 (10)
No	1149 (15)	821 (71)	328 (29)
Public trust in government			
Low level of trust	1970 (26)	1643 (83)	327 (17)
Moderate level of trust	2455 (32)	2107 (86)	348 (14)
High level of trust	3289 (43)	2967 (90)	322 (10)
CVCs for employment			
Agree	4610 (60)	4236 (92)	374 (8)
Disagree	1505 (20)	1213 (81)	292 (19)
Neutral	1599 (21)	1268 (79)	331 (21)
CVCs for education			
Agree	5364 (70)	4950 (92)	414 (8)
Disagree	938 (12)	664 (71)	274 (29)
Neutral	1412 (18)	1103 (78)	309 (22)
CVCs for events			
Agree	5661 (73)	5200 (92)	461 (8)
Disagree	791 (10)	537 (68)	254 (32)
Neutral	1262 (16)	980 (78)	282 (22)
CVCs for hospitality			
Agree	5666 (73)	5207 (92)	459 (8)
Disagree	709 (9)	464 (65)	245 (35)
Neutral	1339 (17)	1046 (78)	293 (22)
CVCs for domestic travel			
Agree	5753 (75)	5275 (92)	478 (8)
Disagree	733 (10)	478 (65)	255 (35)
Neutral	1228 (16)	964 (79)	264 (21)
CVCs for international travel			
Agree	6159 (80)	5605 (91)	554 (9)
Disagree	566 (7)	364 (64)	202 (36)
Neutral	989 (13)	748 (76)	241 (24)

Note: Column 2 provides a breakdown of total responses for all variables and their sub-categories, (%) are additive at column level. Columns 3, 4, & 5 provide

response to the questions of whether respondents would adopt CVCs (Yes, No, and No response) and breakdown is given by individual variable, (%) is additive at row level.

Table 1.

3.2. Factors associated with opposition of CVCs

In this section, we report findings on factors associated with opposition to CVCs from the two separate logistical regression models.

3.2.1. Model 1 (vaccination status excluding the reasons for being unvaccinated)

Unvaccinated people compared to those vaccinated were two times more likely to oppose CVCs (OR: 2.01, 95% CI 1.65–2.46). Compared to people who placed high levels of trust in their governments, those who placed low level of trust were more likely to oppose CVCs (OR: 1.25, 95% CI: 1.02 - 2.52). People without travel plans in 2021 compared to those with travel plans were more likely to oppose CVCs (OR: 1.58, 95% CI: 1.31–1.90). People who did not want existing NPIs to continue compared to those who did were almost three times more likely to oppose CVCs (OR: 2.97, 95% CI: 2.51–3.53). Compared to people who perceived CVCs to bring financial benefits to their occupational sector, those who did not perceive any benefits were twice as likely to oppose CVCs (OR: 2.35, 95% CI: 1.98–2.78). Compared to those who agreed using CVCs for employment, events, hospitality, and domestic travel purposes, those who disagreed for the same purposes were more likely to oppose CVCs. Interestingly, results on opposition to CVCs for foreign travel was not statistically significant. Full results are reported in [Table 2](#). Sensitivity analysis conducted by counting those who only received 1st dose as unvaccinated did not change the results as provided in [Supplementary 2](#).

3.2.2. Model 2 (vaccination status including reasons for being unvaccinated)

Compared to those vaccinated, people who had no intention of getting vaccinated and those who were still considering getting vaccinated were more likely to oppose CVCs with ORs of (4.25, 95% CI: 2.24–8.08) and (3.16, 95% CI: 2.19–4.55) respectively. Similarly, those who had registered and waiting for their 1st dose (OR: 1.49, 95% CI: 1.10–2.02) and those wanting a different brand of vaccines (OR: 1.96, 95% CI: 1.10–3.51) were more likely to oppose CVCs compared to those already vaccinated. The ORs for those who said vaccines were not available in their country or were not in priority group were not statistically significant. The ORs of all other variables (same as in model 1) were comparable to findings in model 1 as reported in [Table 3](#).

Findings from both models were largely consistent when analysed separately for countries with sample >1,000 (total n = 5,624). However, ORs of opposition to CVCs in relation to low level of trust in government and disagreement on different purposes of CVCs were no longer statistically significant. For countries with a sample <1,000 (total n = 2,081), vaccination status no longer explained opposition to CVCs except for those who said they were still considering getting vaccinated. Low level of government trust explained opposition to CVCs while travel plans in 2021 did not. Country-level results were most consistent to the main results for the Philippines only while other countries yielded mixed results. Summary results are available in [Supplementary 2](#).

4. Discussion

Our study examined factors associated with opposition to CVCs among the public in 9 Asian countries using primary data collected through a regional online survey.

Table 2

Odds ratios, 95% confidence intervals, and *p*-values for responding “no” regarding adoption of CVCs from Model 1.

Variables	Multiple logistic regression (Odds Ratio: OR)		
	OR for those who opposed the use of vaccination certificate (compared to those who accepted the use of vaccination certificate)	95% Confidence Interval (CI)	P-value
Vaccination status (Ref: Vaccinated)			
Unvaccinated	2.01	1.65–2.46	0.000
Trust in government (Ref: High trust)			
Low level of trust	1.25	1.02–2.52	0.031
Moderate level of trust	1.21	1.00–1.45	0.048
Travel plan in 2021 (Ref: Have travel plan)			
Do not have travel plan	1.58	1.31–1.90	0.000
Continue NPIs (Ref: continue NPIs)			
Do not continue NPIs	2.97	2.51–3.53	0.000
Financial benefit (Ref: anticipate financial benefit)			
Do not anticipate financial benefit	2.35	1.98–2.78	0.000
Unemployed	1.40	0.99–1.98	0.058
CVCs for employment (Ref: Agree)			
Disagree	1.48	1.16–1.88	0.002
Neutral	1.47	1.19–1.82	0.000
CVCs for education (Ref: Agree)			
Disagree	1.45	1.10–1.89	0.007
Neutral	1.49	1.20–1.84	0.000
CVCs for events (Ref: Agree)			
Disagree	1.62	1.23–2.14	0.001
Neutral	1.50	1.19–1.90	0.001
CVCs for hospitality (Ref: Agree)			
Disagree	1.50	1.12–2.01	0.007
Neutral	1.17	0.93–1.47	0.177
CVCs for domestic travel (Ref: Agree)			
Disagree	1.48	1.12–1.95	0.005
Neutral	1.08	0.85–1.37	0.542
CVCs for international travel (Ref: Agree)			
Disagree	1.30	0.96–1.76	0.088
Neutral	1.14	0.89–1.46	0.298
Gender (Ref: Male)			
Female	1.07	0.91–1.26	0.401
Other	0.92	0.29–1.93	0.890
Education (Ref: High school or lower)			
No formal schooling	1.00		
Undergraduate	0.71	0.57–0.90	0.004
Postgraduate or higher	0.63	0.49–0.82	0.000
Country (Ref: India)			
Indonesia	0.51	0.35–0.75	0.001
Japan	0.61	0.46–0.82	0.001
Laos	0.37	0.20–0.71	0.003
Malaysia	0.48	0.26–0.87	0.016
The Philippines	0.47	0.38–0.59	0.000
Singapore	0.39	0.22–0.68	0.001
South Korea	0.97	0.74–1.28	0.838
Thailand	0.33	0.24–0.44	0.000

4.1. Vaccination status, vaccine hesitancy, and inequitable access to vaccines

Our findings suggest that status of vaccination (being unvaccinated) is a strong predictor of people’s negative attitude towards CVCs. This finding is consistent with previous evidence from Switzerland [17] and the US [18] but was not observed in the study from China [23]. To further understand this phenomenon, we modelled people’s reasons for remaining unvaccinated against those vaccinated. We found vaccine resistant (those with no intention of getting vaccinated) and hesitant groups (those still considering getting vaccinated) were significantly more likely to oppose CVCs as compared to those already vaccinated.

Table 3

Odds ratios, 95% confidence intervals, and *p*-values for responding “no” regarding adoption of CVCs from Model 2.

Variables	Multiple logistic regression (Odds Ratio: OR)		
	OR for those who opposed the use of vaccination certificate (compared to those who accepted the use of vaccination certificate)	95% Confidence Interval (CI)	P-value
Vaccination status (Ref: Vaccinated)			
Registered and awaiting 1st dose	1.49	1.10–2.02	0.011
Still considering getting vaccinated	3.16	2.19–4.55	0.000
No intention of getting vaccinated	4.25	2.24–8.08	0.000
Vaccine not available in the country	1.77	0.58–5.36	0.314
Not in priority group	1.55	0.95–2.52	0.077
Want a different brand of vaccine	1.96	1.10–3.51	0.023
Trust in government (Ref: High trust)			
Low trust	1.24	1.01–1.51	0.039
Moderate trust	1.21	1.01–1.46	0.044
Travel plans in 2021 (Ref: Have travel plan)			
Do not have travel plan	1.57	1.31–1.89	0.000
Continue NPIs (Ref: continue NPIs)			
Do not continue NPIs	2.95	2.48–3.50	0.000
Financial benefit (Ref: anticipate financial benefit)			
Do not anticipate financial benefit	2.33	1.96–2.76	0.000
Unemployed	1.42	1.01–2.00	0.046
CVCs for employment (Ref: Agree)			
Disagree	1.48	1.16–1.89	0.002
Neutral	1.47	1.19–1.82	0.000
CVCs for education (Ref: Agree)			
Disagree	1.44	1.10–1.89	0.009
Neutral	1.49	1.20–1.84	0.000
CVCs for events (Ref: Agree)			
Disagree	1.62	1.22–2.14	0.001
Neutral	1.50	1.19–1.90	0.001
CVCs for hospitality (Ref: Agree)			
Disagree	1.49	1.11–2.01	0.008
Neutral	1.18	0.93–1.48	0.167
CVCs for domestic travel (Ref: Agree)			
Disagree	1.46	1.10–1.92	0.008
Neutral	1.07	0.84–1.36	0.594
CVCs for international travel (Ref: Agree)			
Disagree	1.25	0.92–1.70	0.153
Neutral	1.13	0.88–1.45	0.328
Gender (Ref: Male)			
Female	1.08	0.92–1.27	0.361
Other	0.95	0.30–2.99	0.931
Education (Ref: High school or lower)			
No formal schooling	1.00		
Undergraduate	0.71	0.56–0.89	0.003
Postgraduate or higher	0.63	0.49–0.82	0.000
Country (Ref: India)			
Indonesia	0.50	0.34–0.74	0.000
Japan	0.62	0.46–0.83	0.002
Laos	0.37	0.19–0.70	0.003
Malaysia	0.47	0.26–0.87	0.016
The Philippines	0.48	0.38–0.60	0.000
Singapore	0.38	0.22–0.68	0.001
South Korea	0.96	0.72–1.27	0.757
Thailand	0.35	0.26–0.47	0.000

These nuanced findings, while intuitive, have not yet been reported in the literature. A study in the UK, when only looking at those unsure about getting vaccinated, found that the introduction of CVCs to lower their intentions of getting vaccinated [15]. While their study explored this relationship in reverse and cannot be inferred directly, it highlights people's attitude toward CVCs when they are concerned about the vaccines being provided. Mistrust and low levels of confidence in COVID-19 vaccines which have contributed to vaccine hesitancy [14, 28], may have translated into views on CVCs. Prevalence of COVID-19 vaccine hesitancy in LMICs in Asia albeit low relative to other regions [29], still poses a threat to establishing herd immunity and preventing future evolution of the virus. Policymakers in the region could use this evidence to prioritise addressing COVID-19 vaccine hesitancy and resistance if CVCs are to be widely accepted by the public. Governments may consider communicating the 'personal benefits' of getting vaccinated in comparison to 'collective benefits' to the strongly hesitant groups; this has been found to reduce vaccine hesitancy to a greater extent during this pandemic [29–31]. Avoiding hospitalisation or long-COVID could be examples of such personal benefits. Further, countries are adopting 'risk-based' border measures where health system capacity is a key determining factor [24]. It is in the interest of public to reduce burden on health systems by getting vaccinated such that (i) cross-border socioeconomic activities can return and (ii) they are able to receive medical treatment, COVID-19 or otherwise. Vaccine mandate and mandatory CVCs, although highly debated topics, have shown to increase vaccine uptake in Europe [32,33]. Policymakers could explore using CVCs as additional policy tool to address vaccine hesitancy. However, we urge understanding the reasons for vaccine hesitancy prior to implementing such policies as unspoken hesitancy left unaddressed may only exacerbate the issue [34]. Further, enforcement of mandatory COVID-19 policies have been found to crowd out voluntary support [35]. However, vaccine mandates have resulted in growing global cases of counterfeit CVCs [36], consequences of which can be detrimental to health systems. Hence, digital CVCs with reliable verification systems should accompany any such mandates.

Given the findings from this study, future research could explore whether addressing vaccine hesitancy and resistance increases the acceptance of CVCs and vice versa. Insights from such studies could provide implications for safer and more open borders. They could further highlight how incentives, such as freedom of movement provided by CVCs, may be used to address vaccine hesitancy across other disease areas.

Further, our study highlights the significance of improving access to vaccines for wider adoption of CVCs which has not been previously reported. Those willing to but unable to get vaccinated (or with the vaccine of their choice) also opposed CVCs, although the magnitudes of opposition were far less than vaccine resistant and hesitant groups. Those who are unvaccinated due to lack of access will naturally be excluded from reaping the freedom awarded by holding CVCs. This absence (or delay) in utility of CVCs may explain this negative attitude towards CVCs, and increasing access may help overturn such opposition. During the study period, in most countries, vaccination eligibility was limited to the elderly and healthcare workers, and choice to preferred vaccines were not available. Further, vaccination was also not a mandate (see Table 1, Supplementary 3). Hence, it can be argued that at present, such groups may well be supportive of CVCs given increased eligibility, choice, and even mandate in some countries. While the findings are regional, the issue of CVCs is a global one with multisectoral implications. It is in the interest of global and regional leaders to therefore prioritise vaccine distribution to the Global South which is expected to yield high returns in advancing global immunisation coverage [29] which could translate into higher economic growth for all countries through safer and open borders [22].

In addition to CVCs, policymakers could explore using immunity certificates to accelerate resumption of socioeconomic activities. Such complementary certificates could cater for those opposing CVCs,

especially among vaccine hesitant groups and enhance equity for those without access to vaccines. However, public support for immunity certificates has been mixed [19,37,38] due to concerns such as deliberate exposure to infection, uncertainty surrounding immune protection against new variants, implementation cost, accuracy and validity of serological testing, among others [20,39]. A separate study on this could be beneficial.

4.2. Financial gains, travel plans, and purpose of CVCs

With little surprise, we found people with no expectation of financial gains to their occupational sector (and therefore to themselves) through adoption of CVCs were significantly more likely to oppose them. This phenomenon of 'personal benefits was also observed in the study conducted in China [23]. This belief may be explained by the respondents' occupational sectors. For example, those in agriculture, IT, or unemployed may not be direct beneficiaries of CVCs compared to those in industry, trade and services, and therefore, more likely to oppose CVCs. However, CVCs can provide indirect financial benefits through multiplier effect from across sectors and countries [22] and non-financial personal benefits by allowing social activities to resume and improve mental and physical well-being [40]. Communicating these wider personal benefits (which have proven effective in addressing vaccine hesitancy) of CVCs may improve acceptance.

In line with our hypothesis, we found people with no plans for travel in 2021 were also significantly more likely to oppose CVCs in our study. This may be explained by the absence of direct personal benefits from CVCs, especially if respondents see easing travel as the only purpose of CVCs. Considering this evidence, it may be premature to suggest that CVCs exacerbates equity in relation to travel. If strong opposition to CVCs is being led by groups who have no need or intention to travel, arguments can be made that such actions are prohibiting freedom of movement for those who have needs and intend to travel using CVCs. However, equity effects of CVCs on those with no travel plans have not been examined before and warrants further research. While our finding is intuitive, acceptance of CVCs and plans for future travel may be correlated with the purpose of travel, for example, medical, tourism, business, etc., which our study did not examine due to limited sample size. Future studies could explore this.

Our study also explored how opposition to CVCs was related to people's disagreement on different purposes of CVCs. Consistent with previous studies [11,20], we found people who disagreed with using CVCs for employment, education, events, hospitality, and domestic travel purposes, were also more likely to oppose CVCs. While the same could not be said for foreign travel. Foreign travel may have been considered as non-essential and optional, therefore purposing CVCs for such would not impact daily lives. However, employment, education, events, hospitality, and domestic travel are tied to domestic socioeconomic activities which can have profound impact on people's lives [40]. Hence, requiring CVCs to participate in these activities may be seen as discriminatory and an infringement on their rights. Reducing opposition to CVCs may require governments to balance economic recovery (by relaxing international borders for those holding CVCs) and safeguard public health (by leveraging existing NPIs) without mandating CVCs for such scenarios.

4.3. Public trust and compliance to public policies

Our findings that people with low public trust in government are associated with significant opposition to CVCs align with previous research [19]. We also found people who oppose continuation of existing NPIs are highly likely to oppose CVCs, partly confirming previous findings [11]. Government's response to COVID-19 pandemic and governance traits such as 'accountable', 'honest', and 'transparent' have been found to be fundamental to winning public trust [41]. Further, public trust has played a crucial role in public compliance to public

health policies such as adherence to existing NPIs [27] and in addressing vaccine hesitancy [28]. Given such findings, governments should solidify public trust by responding to the pandemic with integrated policies. These should be underpinned by economic subsidies (this could address concerns from those anticipating no financial gains from CVCs) and public health measures [41], before opening borders and widely encouraging or mandating use of CVCs.

4.4. Study limitations

There are limitations to our study. Our sample is not nationally representative for several countries and therefore, may not represent the overall view of the region. Online surveys mean responses may be concentrated in groups with greater access to computers, mobile devices, and the internet. Such respondents are likely to be from urban areas, vaccinated, and have more access to credible information about COVID-19 vaccines which could be a source of bias in the study. However, this speculation cannot be established without controlling for such geographical and vaccine knowledge related factors in our model. That said, the use of mobile phones and internet penetration in the nine countries are quite high except for Laos [42] where face-to-face interviews were conducted, and the demographics (sex and age) of majority of the respondents in each country mirror their respective population demographics. Hence, our study offers some insights into the public perspective on CVCs in the region. Unlike other studies [17,18] sociodemographic factors did not explain people's attitude towards CVCs in our study. Pooling data from several countries without controlling for country differences in sociodemographic may have contributed to this. Our results may be biased towards views from just three countries (India, the Philippines, and Thailand) accounting for 73% of the responses used in the analyses. At the country-level, only the results from the Philippines (accounting for 30% of the sample) remained largely consistent with the overall results. This could indicate majority of the results are driven by a single country. However, pooling data from other countries provides a regional perspective and further helped explain associations between opposition to CVCs and vaccines access, travel plans, and purpose of CVCs which the Philippines data alone did not provide.

Our assumptions (treating the responses 'no' and 'unsure' as the same, and likewise for 1st and full dose of vaccination) have no strong theoretical or strong evidence base and may not hold true. Considering the presence of vaccine related opposition observed in our study, extending the definition of CVCs to immunity certificates may have further increased the acceptance of CVCs, especially. Hence, such limitations may have biased the results towards opposition to CVCs. Given, increased vaccine access, choice, and mandate, the opposition to CVCs may have decreased. Collinearity test resulted a mean variance inflation factor (VIF) of 1.31 suggesting low multicollinearity in our model. However, it is likely that vaccination status may be correlated with public trust, travel plans, and preference to continue NPIs which could bias our results. Finally, the low Pseudo R^2 (0.197 for model 1 and 0.200 for model 2) highlights there may be multiple factors such as age, occupation, neoliberal views, personal concerns and perceived virus severity, fairness, nationalism, process of attaining CVCs and their formats (paper or electronic), among others [23,38], associated with public attitude towards CVCs that are not captured in our work.

5. Conclusion

The need for and acceptance of CVCs is growing globally with increasing rate of vaccination and an ever-evolving COVID-19 virus. Our study has identified six groups of people as potential opposers of CVCs: (i) those unvaccinated, especially those who are hesitant and have no access to COVID-19 vaccines, (ii) those who do not want existing NPIs to continue, (iii) those who have low level of trust in governments, (iv) those with no travel plans, (v) those who expect no personal financial

gains from CVCs, and (vi) those who disagree with using CVCs for domestic socioeconomic activities such as employment, education, events, hospitality, and domestic travel. Addressing concerns of these groups can be an important step towards formulating a uniform policy and wider use of CVCs in Asia.

Authors' contributions

SKC, DF, MS, AA, CR, SD managed the administration of the study and created an original version of the online survey with supervision from WI and YT, and review from all co-authors. All co-authors contributed to data acquisition. SKC, DF, MS, AA, and CR performed formal analysis and interpretation. YT, SKC, and WI conceptualised the first draft. SKC, DF, and MS wrote the first draft and finalised the draft. All other authors reviewed, edited, and contributed to the revision of the final draft.

Data and materials availability

The online survey data can be made available upon request.

CRediT authorship contribution statement

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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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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.tmaid.2022.102358>.

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