COVID-19 vaccine acceptance and its associated factors in the Western Pacific Region

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Abstract

Background COVID-19 vaccines effectively reduced the severity of the pandemic, but the mass rollout was challenged by vaccine hesitancy, which was related to heterogenous factors—such as religiosity, mistrust, and a lack of scientific knowledge—around the globe. Distinguishing these potential influencers and quantifying their impacts would help authorities to tailor strategies that boost vaccine confidence and acceptance.

Methods We conducted a large-scale, data-driven analysis on vaccine acceptance and actual uptake in nine Western Pacific countries before (2021) and after (2022) the mass COVID-19 vaccine rollouts. We compared vaccine acceptance or uptake rates between different subpopulations using Bootstrap methods and further constructed a logistic model to investigate the relationship between vaccine endorsement and diverse socio-demographic or trust-related determinants at these two time points.

Findings Substantial between-country differences in vaccine acceptance and uptake were observed across the Western Pacific, with Mongolia, Vietnam, Laos, Cambodia, and Malaysia being more pro-vaccine than the other four countries (Japan, South Korea, Papua New Guinea, and the Philippines). Actual vaccination rates in 2022 were higher than predicted from the 2021 responses for all but Papua New Guinea. Influencers for vaccine endorsement were country-specific, but generally, groups susceptible to vaccine hesitancy included females, the less-educated, and those distrusting vaccines or health care providers.

Interpretation Our findings demonstrate the successful translation of vaccine intent to actual uptake with the deployment of COVID-19 vaccination in the Western Pacific. Increasing vaccine confidence and supressing dissemination of misinformation may play an essential role in reducing vaccine hesitancy and ramping up immunisation.

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Keywords

SARS-CoV-2; Western Pacific; Vaccination; Vaccine confidence; Vaccine hesitancy

1. Introduction

Since the first COVID-19 vaccine was listed for emergency use by the World Health Organization at the end of 2020,[1] mass vaccination campaigns of unprecedented speed have been carried out across the globe. Despite vaccine breakthrough infections being commonplace—due to waning immunity and immune escape of new, more transmissible variants[2]—COVID-19 vaccines have played an essential role in reducing disease severity,[3–5] and have been estimated to have prevented over ten million deaths globally in the first year of their rollouts.[6]

Despite the successes in making vaccines available—at least in middle- and high-income countries and territories—over 2021 and 2022,[7] the success of the global rollouts was challenged[8] by an ongoing reluctance to be vaccinated, namely by *vaccine hesitancy*,[9] which is a major threat to immunisation in general. Reasons for vaccine hesitancy are often country-specific, but may include low risk perceptions and lack of confidence in vaccines or in entities that make decisions and deliver them.[9] Another contributor is exposure to misleading information such as conspiracies.[10] Other factors, such as religious beliefs and education received, are also likely to influence perceptions towards vaccination.[11,12]

Beyond the impact that vaccine rejection has on risks of virus transmission and infection,[13,14] it also may lengthen the time needed for the vaccinated proportion in the general community to arrive at the level required for herd immunity in the absence of large-scale infections,[15] and thereby prolong the economic and social impact of the pandemic. Furthermore, clustering of unvaccinated individuals, as is often the case, increases a population's vulnerability to local outbreaks, demanding an even broader vaccination coverage in the rest of the population to eliminate the disease.[16] Therefore, it is vital to pinpoint the features of groups with high vaccine hesitancy so that policy-makers and other stakeholders could propose effective strategies of strengthening vaccine confidence and encouraging uptake among these groups.[17,18]

Although much effort has been invested over the past few years to uncover the underlying related factors of vaccine confidence and acceptance.[15,19] few works have focused on sentiments towards the COVID-19 vaccines in the general community in Asia Pacific, where stringent control measures in the first year of the pandemic[7,20] led to low levels of naturally-acquired immunity. To fill this gap, our study targets at people's inclination to vaccination in nine countries in the Western Pacific region both before (in 2021) and after (in 2022) the mass COVID-19 vaccine rollouts. We begin by identifying the country-level differences in attitudes towards vaccine and the associations between vaccine intent and the actual uptake, following which we explore variations among diverse subgroups within one country (e.g., people of different ages or genders). Finally, we quantitatively assess how assorted potential influencers—socio-demographic properties, people's trust in vaccine and susceptibility to misinformation—jointly affect the vaccine hesitancy over time, and the heterogeneities in the extents to which each individual factor is correlated with individual acceptability of COVID-19 vaccination.

2. Methods

Data

As part of the longstanding Vaccine Confidence Project,[21] two nationally-representative surveys were conducted in nine Western Pacific countries (Mongolia, Japan, South Korea, Vietnam, Laos, Cambodia, the Philippines, Malaysia, and Papua New Guinea) in 2021 and 2022, wherein the respondents were asked for their knowledge, perceptions and attitudes towards the COVID-19 vaccines, together with their socio-demographic characteristics. These two time periods are mostly in the early stage of (June–August, 2021) and after (May–June, 2022) the mass rollout of COVID-19 vaccination in these countries (Table S1). Each national survey involved approximately 1000 respondents except for Papua New Guinea (~500). The 2022 survey was weighted by age and gender. More details regarding how the surveys were conducted, socio-demographic information of the samples by country and data completeness for each survey are listed in the Supplementary Information (Table S3–5).

The survey questions of interest in our study are presented in Table 1. Analogous trust- and misinformation-related statements in the two surveys (e.g., 'I think new COVID-19 vaccines would be safe" [in 2021] and "I think the COVID-19 vaccines are safe" [in 2022]) were treated as the same questions to allow for comparisons between the two surveys. We recoded answers to all but the question regarding vaccination status into a five-point Likert scale (Table S6), in which a higher level, or score, represents more confidence in vaccine, or scepticism of vaccine-related misinformation that conflicts with the best expert evidence available at the time.[22] The responses to the question "Have you been vaccinated against COVID-19?", on the other hand, were utilized to derive the number of doses one respondent had received by the time of the survey in 2022; answers of "Don't know" or "Refused" (overall 2·1%, but mainly from Malaysia (1·1%), Japan (5%), and South Korea (10%)) were treated as missing.

Statistical analysis
Vaccine endorsement in 2021 was measured through people's feedbacks on the question "Would you accept the COVID-19 vaccine for yourself", wherein a positive response of "definitely yes" or "unsure but leaning towards yes" was regarded as supporting vaccine, while in 2022 respondents who had received at least one dose of the COVID-19 vaccines were taken to be supportive. These two questions were selected due to a shift from limited to universal, free access of the COVID-19 vaccines among the adult population in most countries investigated between the two time points when the surveys were conducted.[7]

Proportions of people supporting the COVID-19 vaccines in 2021 and 2022 by socio-demographic characteristics, including age, gender, education level, and religion, as well as the differences in proportions between different sub-populations, were estimated with the bootstrap method using sampling weights, in which we excluded individuals missing the demographic information in question.

We further constructed a logistic regression framework to investigate how different factors collectively influenced vaccine endorsement over time. A time variable was introduced to account for potential changes in attitudes towards the COVID-19 vaccines.[23] Apart from time and the aforementioned socio-demographic covariates, we further incorporated responses to some trust- and misinformation-related questions (Table 1) into the model, in which a trust score ranging was calculated using principal component analysis for each individual based on his or her perceptions towards the safety, importance and effectiveness of the COVID-19 vaccines. We fitted the logistic regression model for each respective country and subsequently employed a random-effects meta-analysis approach to amalgamate the coefficients. We assumed the impacts of these factors on vaccine endorsement time-invariant and tested this assumption in a subsequent sensitivity analysis (Table S14–16). Considering the potential existence of disparity between intention and actual behaviour to get vaccinated in 2022 (Table S17),[24] we further conducted a sensitivity analysis using the same regression model but different measures for vaccine endorsement. We used multiple imputation to compensate for the missing socio-demographic data (13% and 7% for the 2021 and 2022 surveys respectively) and responses to the trust-related questions in the 2022 survey (6%). Full details of the principal component analysis, the imputation approach and the regression model are provided in the Supplementary Information. All the analyses and visualization were done with R.[25]

Role of the funding source
The funders of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

3. Results

People's perceptions towards the seven survey questions were heterogenous across space and time, but generally, Vietnamese, Laotians, and Cambodians were the most likely to believe the COVID-19 vaccines are safe, important, and effective (Figure 1). High associations were also observed between responses to these three statements in both surveys (Table 2).

Vaccine endorsement for the nine Western Pacific countries in 2021 and 2022, in terms of the weighted average willingness to accept the COVID-19 vaccine (2021) and actual vaccination status (2022) respectively, is shown in Figure 2. There were substantial differences in sentiments towards vaccine between countries, but attitudes were relatively consistent across the two time points. To be more specific, people in Japan, South Korea, and Papua New Guinea tended to be less positive towards the COVID-19 vaccine, where the proportions of the population consenting to accept the COVID-19 vaccine for themselves (henceforth, *vaccine acceptance rate*) in 2021 were 6 percentage points (pp; 95% Bootstrap Confidence Interval [CI]: 3–8pp), 7pp (5–10pp), and 46pp (42–49pp) lower than the average across all the samples from the nine countries. Similar differences were seen in the proportions of people having received at least one dose of vaccine (henceforth, *vaccination rate*) in 2022, being lower by 5pp (3–7pp), 8pp (6–10pp), and 70pp (67–73pp), respectively. It is noteworthy that the actual uptake in Papua New Guinea was lower than predicted based on 2021 responses, perhaps indicating under-supply. Though the vaccine acceptance rate in the Philippines in 2021 was 10pp (7–12pp) lower than the region average, the country had an eventual vaccination rate that was slightly higher by 4pp (2–5pp) by 2022, although the average number of doses received per person at that time was 0·32 (0·27–0·37) smaller, at 1·96 (1·92–2·01), reflecting differences in vaccines available and in the use of booster doses. By comparison, residents in the other countries, including Mongolia, Vietnam, Laos, Cambodia, and Malaysia, were more pro-vaccine in both years. Particularly in Vietnam, the vaccine acceptance rate in 2021 was as high as 95% (93–96%) and only one out of

the 1003 respondents had not been vaccinated by the time of the survey in 2022. It is also worth noting that an average individual in all the countries but Papua New Guinea had received two or three doses of the COVID-19 vaccine as of 2022, while the mean number of doses administered to Papuans was merely 0·32 (0·25–0·38).

While both the vaccine acceptance rate and the vaccination rate of a certain group were largely associated by its country of residence, there existed some potential country-specific factors influencing vaccine confidence. Among the other four demographic characteristics we focused on—age, gender, education, and religion—none was found to play a significantly role in all the nine countries, but each had a substantial impact on a subset of them.

Age had a close association with vaccine confidence and uptake in Japan and South Korea, where elder people were more willing to accept the COVID-19 vaccine for themselves in 2021 and were more likely to receive the vaccine in 2022. The vaccine acceptance rates of people aged over 55 years old in these two countries were 8pp (5–10pp), and 11pp (8–15pp) higher than the country average, respectively, while the numbers for vaccination rates were 7pp (4–9pp) and 12pp (9–15pp). In the Philippines, however, compared with the younger groups, vaccine uptake among the elderly (over 55 years old) in 2022 was not so satisfactory, whose rate was 7pp (2–13pp) lower than the average for the Philippines, despite that the vaccine acceptance rate in 2021 for this group was not significantly lower than the others.

Gender difference in vaccine confidence was also prominent. In 2021, male Japanese, South Koreans, and Filipinos were more likely to accept the COVID-19 vaccines compared to their female counterparts and the proportions were estimated to be 9pp (4–14pp), 6pp (1–11pp), and 6pp (0–11pp) higher, respectively, while in 2022 the impact of gender was significant in more countries with respect to vaccination uptake, even though no obvious distinction was observed among Japanese respondents of different genders. The vaccination rates of males in Mongolia, South Korea, the Philippines, and Papua New Guinea were higher by 3pp (1–5pp), 7pp (3–10pp), 4pp (0–7pp), and 9pp (3–16pp), respectively. In Malaysia, however, the proportion of vaccinated females was even 2pp (0–5pp) higher than that of males.

Effects of education on vaccine confidence were heterogenous across different countries. Those with post-secondary education (i.e., vocational, university, master's, or PhD degrees) were more likely to accept the COVID-19 vaccines in 2021 in Japan, South Korea, Laos, Cambodia, and the Philippines, while with respect to vaccination rates in 2022 the impacts of education were notable for all the countries but Mongolia, Vietnam, and Laos, where over 95% of the population had been vaccinated. Nevertheless, a higher level of education, such as master's or PhD, did not necessarily mean a greater chance of endorsing the COVID-19 vaccines than a lower level like university or vocational education.

As for religion, compared with the country averages, Buddhists and people with no religious beliefs were relatively more willing to accept the COVID-19 vaccine in 2021, as were Christians in South Korea and Muslims in Mongolia and Malaysia. Distinctions were not so great with respect to vaccination rates in 2022, but in countries where the overall vaccination rates were not so high, such as Japan, South Korea, and Malaysia, the proportions of the vaccinated among people believing in Buddhism were higher than the country averages by 8pp (6–10pp), 12pp (8–14pp), and 2pp (0–4pp) respectively.

In agreement with the aforementioned comparisons, which used bootstrapping, results of the regression analysis (Figure 3, Figure S1, Table S10–11) suggest that the probability of one being vaccinated in 2022 was significantly higher than that reflected from the willingness to accept the COVID-19 vaccines in the 2021 survey in all the countries but Papua New Guinea, where one was significantly less likely to have received one dose of the COVID-19 vaccines in 2022 than to hold a positive attitude towards the vaccine one year before (odds ratio [OR] 0·17, 95% CI 0·11–0·24). Furthermore, the results were not fundamentally changed when we took into account the potential impacts of intention-behaviour gap on the evaluating vaccination endorsement in the Western Pacific countries. Similar effects of various factors were observed, while we saw no prominent improvement in the vaccine intent among the unvaccinated Papuans in 2022 (Figure S2, Table S18).

Vaccine endorsement among people over 55 years old tended to be weaker than the younger generations, except for Japan, South Korea, and Papua New Guinea. The phenomenon was notable in the Philippines, where the odds ratio for supporting the COVID-19 vaccine among people aged over 55 against people between 18 and 24 was only 0·46 (0·28–0·75). We found that Mongolians aged between 25 and 34 were also less supportive, with an odds ratio of 0·42 (0·23–0·79), compared to their compatriots aged under 25. In all but Vietnam, Laos, and Malaysia, males tended to support the COVID-19 vaccine more, but the gender difference was significant only in Papua New Guinea, while effects of education and religion were similar to the previous comparisons with the

country average, except that a decrease, though not significant (OR 0·83, 95% CI 0·38–1·8), was found among the well-educated people in South Korea.

The regression results also indicate a strong link between vaccine endorsement and responses to the trust- or misinformation-related questions. One level's elevation in either trust score or trust in health care providers was associated with a remarkable rise in the odds ratio of being supportive of the COVID-19 vaccine, but the association with trust in health care providers was not as powerful as that of the three-question vaccine confidence level for all the countries but South Korea. By comparison, the positive correlation was not so robust between vaccine endorsement and scepticism of misinformation, which was measured through respondents' attitudes towards the statement "Vaccine trials had led to deaths of people", as was evidenced by the coverage of 1 in the majority of the 95% confidence intervals.

4. Discussion

We have conducted a quantitative analysis on responses to questions of vaccine confidence early and late in the deployment of COVID-19 vaccines in two large surveys of countries in the Western Pacific, demonstrating great variations in COVID-19 vaccine endorsement and the impacts of different factors among the nine Western Pacific countries studied.

Vaccine hesitancy was most prominent in Papua New Guinea, whose routine vaccination coverage was low prior to the COVID-19 pandemic.[26] Although the COVID-19 vaccine rollout there started from May 2021,[27] geographical inaccessibility, in terms of travel time to health facilities, remained a major barrier to vaccine promotion in the country.[26] While the relatively low diagnosed case counts (no more than 1000 per day) in the country throughout 2021 and 2022 might contribute to people's low risk perception and hence weaker vaccination intention,[28] the low willingness and eventual vaccine uptake may also have been a consequence of the lack of trust or a scientific understanding of the COVID-19 vaccines, which was also associated with a stronger tendency to believe misinformation in the population (Figure 1).

The reluctance to accept vaccine in Japan and South Korea, the only two high-income countries among the nine investigated, was also documented in a previous analysis of global vaccine confidence between 2015 and 2019,[29] but our work further identified that the disinclination was mainly attributed to younger people, especially those below 25 years old. Nevertheless, we found no agreement amongst different countries on the association between age and vaccine endorsement. For instance, in the Philippines, another country with a below-average vaccine acceptance, the least supportive group consisted of people older than 54. This discrepancy may reflect contextual differences or the plausible existence of latent factors, rather than age itself, that drove people's perceptions towards vaccine, such as the lack of time to take vaccine and the belief that one would not get seriously ill,[30] which may be shared by some age groups in these countries.

Our regression analysis revealed that trust in vaccines, with regard to one's perceptions towards vaccine safety, importance, and efficacy, had a particularly strong positive association with one's vaccine intent or uptake, aligning with the previous finding in Hong Kong that mistrust in vaccine was a major reason for vaccine refusal.[31] This further underscores the importance of the Vaccine Confidence Project[21] and their efforts of developing and utilising the vaccine confidence index to monitor vaccine hesitancy around the globe.[29] Another dominant association was between vaccine endorsement with confidence in health care providers, which has also been identified in other studies alike. Other features associated with higher odds of objection included being female, having less education and believing misinformation, but it is worth noting that such relationship was only statistically significant in some of the regions. Our identification of these correlates of vaccine hesitancy may enable the authorities to tailor appropriate interventions accordingly to promote vaccine uptake among these groups.[13]

In addition, the notable rises observed in the actual COVID-19 vaccine uptake in 2022 compared to the predictions from the vaccine intentions in 2021 for all but Papua New Guinea suggested a growth in vaccine intent within these countries. The improvement can potentially be credited to increasing media exposure to COVID-19 and vaccines, rising concerns about prospective impacts of new, more transmissible variants, and implementation of vaccination-differentiated safe management measures allowing only the vaccinated to resume work, enter shopping malls, or travel abroad.[7,32,33]

Past research, mostly focusing on global or western settings, has identified a robust relationship between religiosity and vaccine acceptance,[34] with higher refusals among people with strong religious convictions,[35] who are more likely to be constrained by religious compatibility issues and vulnerable to religion-related conspiracy

theories.[36,37] In this analysis, however, we found no statistically significant association with vaccine endorsement except in Mongolia (Figure S1). It is also worth noting that we did not find sufficient evidence that Islam led to greater vaccine hesitancy among its Malaysian adherents, despite some other studies reported higher vaccine refusal rates among Muslims owing to the concern that the vaccines were not halal.[38] Nonetheless, identifying the relationship between specific religions and hesitancy in the Western Pacific was challenged by the diverse spectrum of world religions represented in the countries we studied, which made it hard to disentangle religious from country-specific differences.

Limitations of this study include the possible socio-demographic disparities between the survey samples, and the low counts of respondents rejecting the COVID-19 vaccines in pro-vaccine countries like Vietnam and Cambodia, increasing challenges to pinpoint the influencing factors of vaccination endorsement and precisely assess their individual effects. The former problem was resolved by introducing sample weights in our analysis, while the latter was alleviated using Firth's bias-reduced logistic regression.[39] We also noticed discrepancies in actual vaccination rates and those reflected from the survey responses (Table S2), potentially indicating limited national representativeness.

Additionally, we used different, yet analogous, questions—COVID-19 vaccine acceptance and uptake—to measure vaccine endorsement at the two different time points. This was necessitated by the widespread rollout of COVID-19 vaccines in between these surveys, which would have complicated any question of intent among survey respondents as a whole. While this approach would generally pose no issue due to the universal and free access to the COVID-19 vaccines in the Western Pacific by the time of the 2022 survey, the quantification of influencers' impacts on vaccine endorsement may be biased by the potential existence of an intention-behaviour gap.[24] In other words, factors beyond an individual's intention, such as unique personal circumstances, could also affect his or her vaccination behaviour, but they could hardly be captured by our model. We therefore performed a sensitivity analysis which considered unvaccinated individuals willing to accept the vaccines as supporters, and the results showed similar findings to our main analysis (Figure S2, Table S18), suggesting that the intention-behaviour gap may not significantly alter our results.

A further limitation was that, in the regression analysis, we imputed the missing data based on socio-demographic features—including country, age, gender, education levels, and religion—assuming they were the only influencing factors. However, the subset we used might not be comprehensive enough to explain all the variations in the predicted variables and the unexplained uncertainties might bring bias to the estimation results. The amount of missingness in the variables considered herein was minimal for all but Japan, South Korea, and Laos (Table S5, Table S12), and we further conducted a sensitivity analysis in which all the samples with missing responses were omitted to demonstrate that the missing data have not unduly affected the conclusions Table S13).

Nonetheless, there are some merits in our study worth highlighting, beyond the size and timeliness. First, samples in the surveys were drawn and weighted to faithfully reflect distributions of the age, gender, and religion for the adult population in each country. Second, we pooled information from comparable questions in the two surveys to deduce the effects of diverse influencers on vaccine endorsement over time. The two measures for vaccine endorsement in the surveys also shed light on the translation of vaccine intention to the actual vaccine uptake with the realization of mass vaccination in all countries but Papua New Guinea. Furthermore, the regression framework used in our analysis revealed the influences of various socio-demographic and trust-related factors for each country, while the heterogeneities in the impacts of the same predictor demonstrated its interaction with country-level effects.

While our work focuses on the COVID-19 vaccine confidence in the Western Pacific, it may provide public health guidance relevant to vaccines targeting similar infectious diseases to COVID-19 in this region. The strong connection between vaccine confidence and acceptance emphasizes the significance of building trust and the urgency of curbing the spread of misleading information in the general population, so as to foster vaccination readiness and prepare for future outbreaks.

Declaration of Interests
LL and HJL are part of the Vaccine Confidence Project research who received research grants from GlaxoSmithKline (GSK), Merck, and Janssen. These research grants are not associated with the project at hand, but related to research on vaccine confidence around different vaccines.

Authors' Contributions
SJ, LL, and ARC conceived and designed the study. SJ implemented the statistical analysis and created the figures and tables. SJ wrote original draft of the manuscript. LL, HJL, and ARC reviewed and edited the manuscript.

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Ethics statement
Ethics approval for this analysis was reviewed and obtained from the London School of Hygiene & Tropical Medicine (LSHTM 26636).

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Tables

Table 1. Questions of interest and the corresponding possible responses for the survey in 2021 and 2022 respectively.

Questions/Statements*	Time	Responses
Vaccine endorsement		
Would you accept the COVID-19 vaccine for yourself?	2021	Definitely yes; Unsure but leaning towards yes; Unsure but leaning towards no; Definitely no; Don't know; Refused.
Have you been vaccinated against COVID-19?	2022	Yes — I have had one dose; Yes — I have had two doses; Yes — I have had an additional or booster dose; No; Don't know/Refused.
Trust-related		
I think **new** COVID-19 vaccines **would be** safe.	2021	Strongly agree; Tend to agree; Tend to disagree; Strongly disagree; Don't know; Refused.
I think **the** COVID-19 vaccines **are safe**.	2022	As above.
I think **new** COVID-19 vaccines **would be** important.	2021	As above.
I think **the** COVID-19 vaccines **are** important.	2022	As above.
I think **new** COVID-19 vaccines **would be** effective.	2021	As above.
I think **the** COVID-19 vaccines **are** effective.	2022	As above.
How much do you trust the local health care providers who would give you a COVID-19 vaccine?	2021 & 2022	A lot; Some what; Not much; Not at all; Don't know; Refused.
Misinformation-related		
Vaccine trials have led to the death of people.	2021	Definitely true; Maybe true; Maybe false; Definitely false; Don't know; Refused.
COVID-19 vaccine trials have led to the death of people.	2022	As above.

* Emphasis added for analogous trust- and misinformation-related statements.

Table 2. Pearson correlations between responses (on the five-point Likert scale from 1 to 5) to the four trust-related questions in year 2021 (the lower triangle, in yellow) and 2022 (the upper triangle, in blue) respectively.

Pearson correlation	The COVID-19 vaccines are safe.	The COVID-19 vaccines are important.	The COVID-19 vaccines are effective.	Trust the local health care providers.
The COVID-19 vaccines are safe.		0·73	0·73	0·49
The COVID-19 vaccines are important.	0·65		0·79	0·50
The COVID-19 vaccines are effective.	0·70	0·70		0·50
Trust the local health care providers.	0·37	0·39	0·38	

Figures

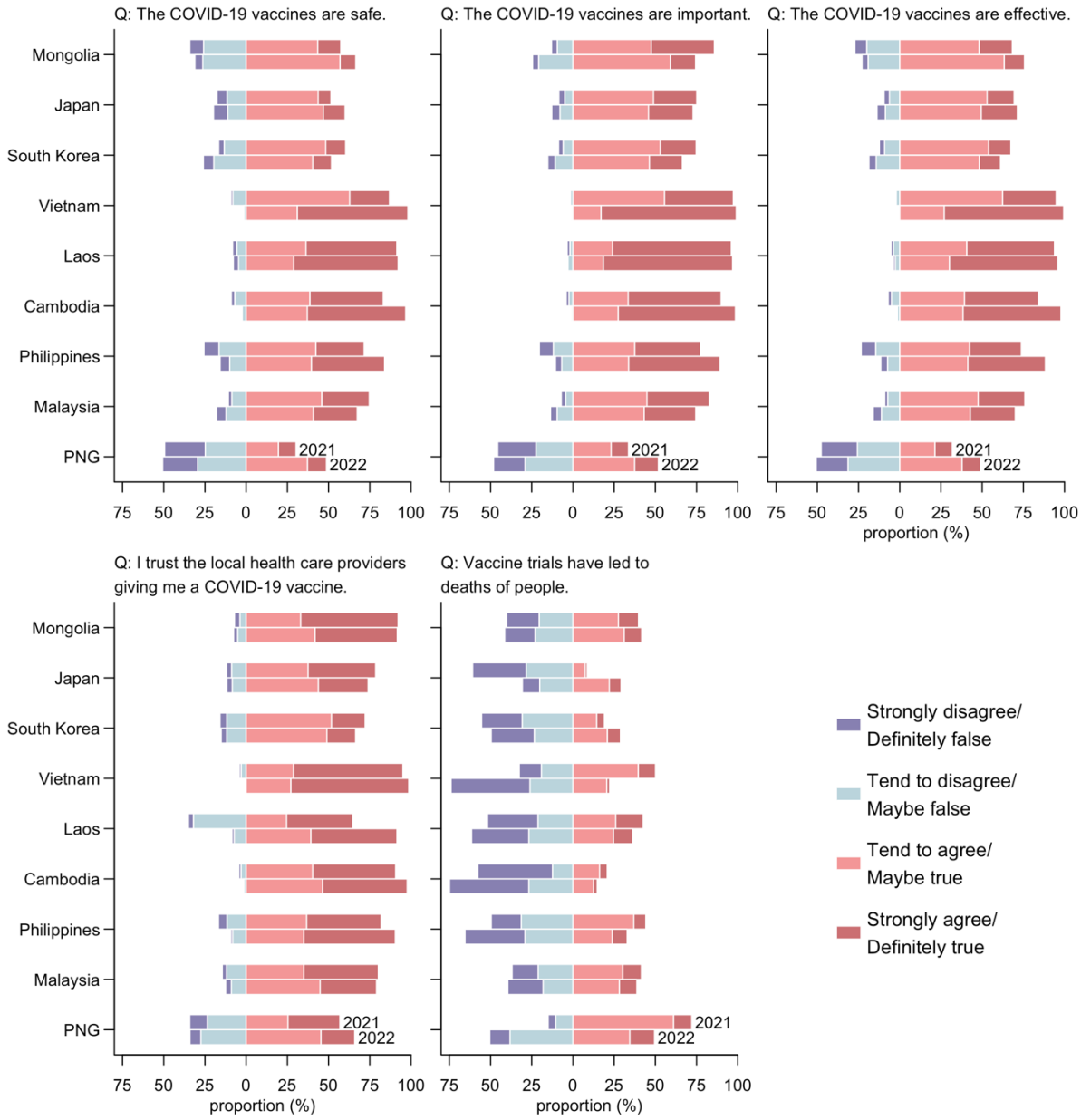

Figure 1. Summary of weighted responses to survey questions by country for the 2021 and 2022 surveys. The extent to which respondents agree with a certain statement is on a five-point Likert scale—strongly disagree, tend to disagree, do not know, tend to agree, strongly agree. Proportions of responses with an answer of "do not know" are removed for presentation purposes. PNG is short for Papua New Guinea.

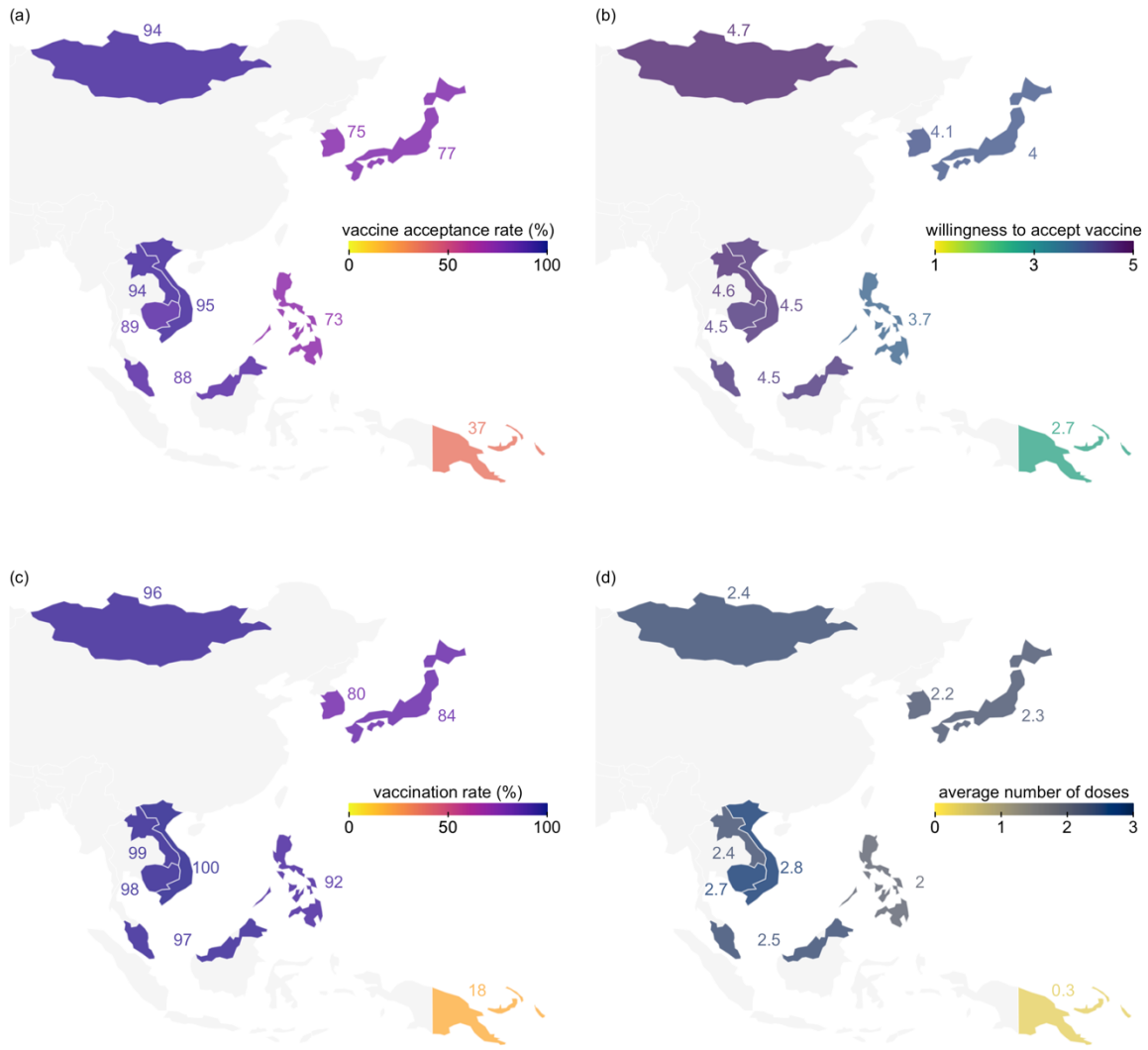

Figure 2. Vaccine endorsement map by country. (a) Percentage of people showing a positive attitude towards vaccine ("strongly agree" or "tend to agree" to the statement "I am willing to accept the new COVID-19 vaccine for myself") in 2021. (b) The average extent to which people in each country were willing to accept the new COVID-19 vaccine for themselves in 2021 (on the five-point Likert scale from 1 [low] to 5 [high]). (c) Percentage of people having received at least one dose of COVID-19 vaccine by the time of the survey in 2022. (d) The average number of doses received by the respondents in each country by the time of the survey in 2022.

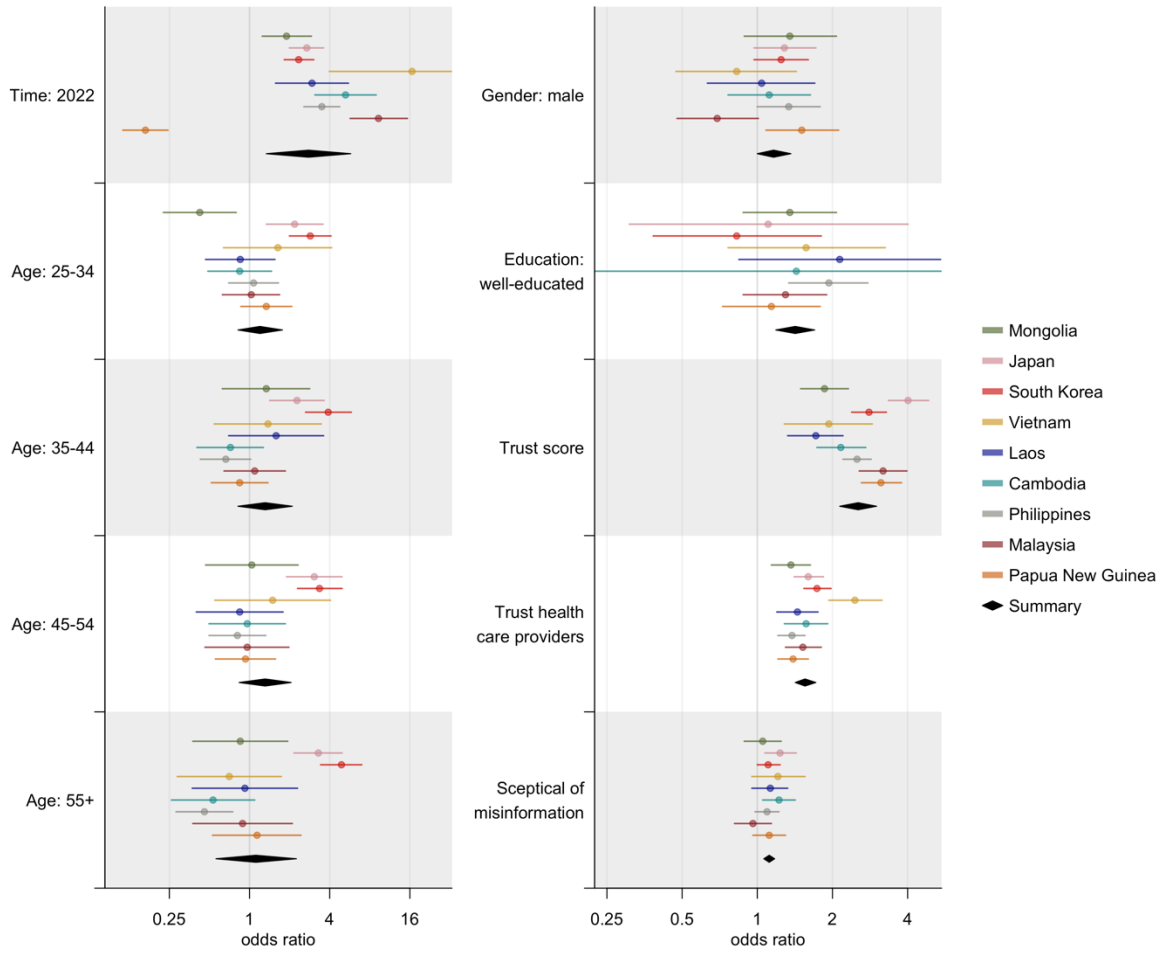

Figure 3. Results of the logistic regression. Odds ratios and 95% confidence intervals for all the factors but religion in the logistic model that infers the contribution of age, gender, education, religion, and responses to some trust- or misinformation-related questions to vaccine confidence for each country in 2021 and 2022. The reference groups for age, gender, and education are people aged between 18 and 24 years old, female, and under-educated (those having received at most secondary education) respectively. Coefficients for people whose genders were neither female nor male are not shown due to the small sample sizes (<20) in either survey. The pooled estimate for each covariate's effect across different countries through a meta-analysis study is shown as the black diamond at the bottom of each block (details in the Supplementary information). Please note the difference in scale on the x-axes and the logarithmic scales.