COVID-19 vaccine acceptance among Malaysians

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Article Info	ABSTRACT
	Since the first declaration of the coronavirus (COVID-19) outbreak, massive number of efforts have been taken to develop and deploy the COVID-19 vaccines. However, there might be hesitation towards the vaccines as there were reports of side effects. This study evaluates the COVID-19 vaccination acceptance of the Malaysian public via an online survey hosted in a COVID-19 vaccination acceptance roadshow event. This study gives an insight to the level of vaccination acceptance of the Malaysian public, while at the same time highlights the possible reasons that vaccination rejection may occur in perspectives that are specific to Malaysians. The overall vaccination acceptance of the Malaysian public is high, as most of them either prefer to get vaccinated or already been vaccinated. Most of them have good knowledge on the safety of COVID-19 vaccines and the importance of vaccination. However, the respondents may have differing opinions on their confidence level towards vaccines by specific manufacturers. These findings give an insight into the COVID-19 vaccination acceptance level of the Malaysian public and may possibly aid in effort for vaccination acceptance should there be any form of pandemic as severe as the COVID-19 pandemic occurring in the future.

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1. INTRODUCTION

The COVID-19 pandemic has been plaguing the globe for more than a year since its official declaration by the World Health Organization [1]. In need of a solution to cope with the new norm, efforts have been poured into developing a safe and effective as well as globally accessible vaccine. With the help of enormous R&D funding by countries around the globe with United States and Germany leading the pack [2], multiple COVID-19 vaccines have been developed in parallel and was even granted emergency use authorization by multiple countries in under a year [3], [4]. To put into perspective, the fastest vaccine ever developed before COVID-19 vaccines is a mumps vaccine, which took four years to go from collecting viral samples to licensing a drug in 1967 [5].

On the 25 of January 2020, the first case of COVID-19 was detected in Malaysia and was traced back to 3 Chinese Nationals [6], [7] Since then, there were multiple occasions that led to huge spikes in COVID-19 cases in the country [8]–[10]. Several movement control orders (MCO) and a Proclamation of Emergency were instated as an effort to flatten the epidemic curve [11]. In Malaysia, the first batch of COVID-19 vaccines arrived on February 21, 2021. In order to instil confidence against the coronavirus vaccines among Malaysians, the Prime Minister of Malaysia announced that he will be the first person in Malaysia to receive a COVID-19 vaccine shot, as the country rolled out its nationwide vaccination campaign on February 24, 2021 [12].

The unprecedented COVID-19 pandemic brought Malaysia's economy to its knees when its gross domestic product (GDP) contracted by 5.6% and as high as 50% of the people suffered from dwindling income and savings following the implementation of the MCO in 2020 [13]. This uncertain times had also cause the Malaysian public to experience numerous ups and downs since the start of the pandemic, which has caused mental distress among Malaysians from all walks of life [14]–[17]. A recent research has even found out that the collective memory of COVID-19 is the largest among 18-30 years old Malaysian due to its impact towards their lives [18]. Unfortunately, the latest Delta variant of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has shown to be more damaging compared to other variants [19], multiple nations including Malaysia have started to administer booster shots to keep the recent spike in COVID-19 cases caused by the aforementioned variant of the virus [20], [21]. With a Nature survey that shows many scientists believing that SARS-CoV-2 will become an endemic virus [22], the vaccine acceptance of the Malaysian public becomes crucial in the hope of mitigating the damage that the pandemic has caused to the nation in terms of social and economy.

With COVID-19 vaccines developed by Pfizer/BioNTech, Oxford/AstraZeneca, Sinovac, CanSinoBIO and Gamaleya Research Institute of Epidemiology and Micrology being introduced in Malaysia, it is important to know the vaccine acceptance among the Malaysian public as it can highly influence vaccine uptake. According to Dubé *et al.* [23], vaccine acceptance is defined as "The degree to which individuals accept, question, or refuse vaccination". As Malaysia is a country that consists of different races [24], there may be ethnic-specific reason to dismiss the idea of getting vaccinated for the coronavirus. The social or cultural motivation behind either acceptance or rejection of the vaccine among the people will have to be studied in order to comprehend the level of understanding of the public towards COVID-19 vaccines, which in turn can help in devising strategic plans to improve vaccine literacy among Malaysian.

With this background, the main aim of this research was to determine the factors that may influence vaccine acceptance among the Malaysian public. The specific objectives were to gauge the willingness of the Malaysian public to accept COVID-19 vaccines, while investigating the possible social and cultural factors that influence their perception towards inoculation as a whole. This research can aid in introducing policies and campaigns that can help in educate the public on the benefits of vaccination, as well as assist in public compliance in future mass vaccination programs.

This study conducted an online survey in order to evaluate the COVID-19 vaccination acceptance among the Malaysian public. This paper is organized as follows. The Literature Review section looks into existing studies that are related to vaccination acceptance around the globe. The Methodology section explains the survey method that has been done in order to conduct the study. Results section is used to present the findings or statistics of the survey. The Discussion section explains the outcomes of the survey and evaluates the vaccination acceptance of the Malaysian public, while at the same time hypothesise the factors that may cause the Malaysian public to further consider on getting vaccinated. Finally, the Conclusion section comprises explanations of the limitations of the study and future works that can be conducted in order to access more insights regarding any social, economics, and political issues that may influence vaccination acceptance among the public.

2. LITERATURE REVIEW

The main factor that contributes against vaccine acceptability is the risk perception of the public, which is their perceived risk towards negative effects that may stem from receiving the vaccine. One of the factors that could contribute to the risk perception of the public towards vaccine is the reported efficacy rate of the vaccine. Harapan *et al.* [25] did a cross-sectional study on acceptance of a COVID-19 vaccine among the Indonesian public. The authors found out that baseline efficacy of vaccines will greatly influence the vaccine acceptance among the general Indonesian population. The efficacy rate of vaccine may be misunderstood as the probability of the person to not be infected with COVID-19 after receiving the vaccine. Kaplan and Milstein [26] conducted a study in which a sample of US citizens were presented with multiple components of vaccine confidence. The results show that vaccine acceptance among the respondents increases when vaccine efficacy increased beyond 70%. According to them, there is a possibility that vaccine efficacy rate maybe misunderstood by the public as the efficiency of the vaccine against the infection [27]. However, according to Haber *et al.* [28] as cited by Shim and Galvani [29], vaccine efficacy measures the protective effects of vaccination by the reduction in the infection risk of a vaccinated individual relative to that of a susceptible, unvaccinated individual. Besides, the World Health Organization (WHO) also states that vaccine efficacy refers to the vaccine's performance in controlled clinical trials, as different vaccine manufacturers may have different approach in trial setups and measurements [30]. The timing of the clinical trials done by vaccine manufacturers may also significantly affect the efficacy number of the vaccine, as the vaccines may have performance impacts toward different variants [31].

The goal of vaccination is to stimulate the immune system to produce antibodies like it would if one were exposed to the disease [32]. In the process of generating resistance to the actual infection, a vaccinated person may encounter minor side effects such as fever and headaches or symptoms such as difficulty in breathing and swelling of face and throat at the more extreme end, although the latter are said to be extremely rare [33]. The possibility of getting severe side effects through vaccination is a genuine concern that causes the public to shift in risk perception and to question the safety of the vaccines themselves. A study done by Akarsu *et al.* [34] found that the fear of side effects of COVID-19 vaccines is one of the common reasons for rejection of vaccination. Ironically, the same fear that is holding the doubters back from getting vaccinated may cause them to experience nocebo effects [35]. Since the fear of the side effects can amplify the vaccine's adverse effects, it will validate other doubters' concern when those who are afraid of the side effects are vaccinated and experience the said effects, further affecting perception and decision making of the others. This is exacerbated when anti-vaccine movements come into play to further mislead the public's perception on COVID-19 vaccines. Study done by Johnson *et al.* [36] through mapping out a network of views on vaccination on Facebook shows that although anti-vaccination pages tend to have lesser followers than pro-vaccination ones, the former are able to reach into discussions on other Facebook pages where the stance on vaccination for followers on the said pages are still undecided. Although legal regulations require the vaccine makers to fully disclose the potential side effects of the developed vaccine, such transparency may sometimes influence the decision-making and symptoms perception of the public. Rief [37] suggested that instead of stating the probability of experiencing a particular adverse effect, the probability of not experiencing the side effects should be presented to the public instead. Also, a list of information about the likelihood of experiencing the side effects should also be introduced from the very common to the very rare types, which allows the user to more accurately estimate the possibility of adverse effect to occur.

The public negative outlook of COVID-19 vaccines can be related to political factors as well. Kreps *et al.* [38] did a study on factors associated with the likelihood of US adults to accept COVID-19 vaccination. In terms of political attributes, the US public shows lower probability of choosing a vaccine if it is developed in China. The probability of getting a vaccine endorsed by the United States former president Donald Trump is the lowest, which is just slightly lower than if it is endorsed by President Joe Biden. The public shows more confidence in the vaccine if it is recommended by the Centers for Disease Control and Prevention (CDC) and the WHO, as confidence towards the health system is one of the significant factors towards the acceptance of COVID-19 vaccine among the public [39]. Moving to the Africa continent, the late Tanzanian president John Magufuli has shown hesitancy towards the vaccines which were manufactured abroad. The deceased who was also a former chemistry teacher had publicly expressed his doubt towards the safety of masks and vaccines against the coronavirus [40]. Tanzanian Health Minister Dorothy Gwajima has also publicly stated that Tanzania has no intention in getting COVID-19 vaccine, while stating that natural remedies are the best way to cure the infection [41]. Although the nation placed an order for COVID-19 vaccines through the African Union [42], there remains deep-rooted scepticism among the public which stems from not being part of the healthcare system as a large portion of the community prefers traditional medicine over proven biological approach in treating illness [41]. Furthermore, the banning of information sharing on outbreaks without government approval might limit the amount of accurate information among the people which exacerbate the spread of misleading information among the community [43].

Low vaccine acceptance among the public may also originate from controversies around the COVID-19 vaccines in general. The vaccine developed by Oxford and AstraZeneca is supposed to be more accessible compared to the other vaccines since it is priced lower and requires only normal refrigeration [44]. However, error in vaccine trial results in the form of dose miscalculation [45], as well as reports of blood clots after using the vaccine [46] has caused hesitation towards the vaccine. As these incidents have affected the public outlook towards the vaccine brand itself, the perceived safeness of the vaccine have led to European countries to suspend the use of the vaccine [47]. There are also an increased number of Australians that reject vaccination entirely [48] due to the risk of getting blood clots after administering the AstraZeneca vaccine. The introduction of European Union's (EU) Digital COVID Certificate, which excludes the AstraZeneca vaccine manufactured in other Asian countries [49], may convey a false impression to the rest of the world that the particular variant of vaccine is subpar compared to vaccines by other manufacturers. The reason of the exclusion of Asian variant of the AstraZeneca vaccine is not given by the European Union, but they had stated that the European Medicines Agency (EMA) assesses the manufacturers based on the manufacturers' detailed information of manufacturing the vaccine [49]. This incident caused dissatisfaction among the African population [50], as they may perceive that the version of the vaccine that they were able to get is not as good as what is offered in countries under European Union. The Malaysians may experience a wave of infodemic based on the negative publicity of COVID-19 vaccines which may hamper vaccination efforts laid down by the Malaysian authorities to achieve herd immunity. The initial doubters against COVID-19 vaccines might be swayed by this political news, pushing them over the edge to deny the vaccine altogether.

Since Malaysia is a religious country, vaccine acceptance among Malaysian may also be hampered by the public's own religious belief. A survey done by Syed Alwi *et al.* [51] found that 20.8% of the respondents were hesitant towards COVID-19 vaccines due to religious and cultural factors. As the community of Muslim people are the majority population in Malaysia at 61.3% [52], the concern on whether vaccines used in the country is deemed "halal" has to be addressed. According to Public Health England [53], porcine gelatine is used in vaccines as a stabiliser to ensure that the vaccine remains safe and effective during storage. That would raise the concern that any form of consumption on the origin animal that porcine gelatine is extracted from, the pig, which is considered as forbidden for Muslims. Although the official Islamic ruling on the usage of COVID-19 vaccine is permitted since it is in line with Islamic Sharia's objectives on the protection of the human body, fake news on the vaccines' halal status [54] continues to plague the vaccine acceptance among Malaysian Muslims. In addition to that, the inconsistency in declaring a few brand of COVID-19 vaccines being 'halal' [55] or the specific brand of vaccines that are recognised for pilgrimage purposes [56] by other countries may also lead to the interpretation of other brand of vaccines that are not being identified by major Islamic countries as 'non-halal'. Islamic countries need to reach a consensus on consistently verifying whether COVID-19 vaccines are permitted to be used to eliminate any uncertainty on the matter.

As of August 22, 2021, there are currently 40.77% of the population in Malaysia that has completed their vaccination [57]. Although the nation's vaccination rate is placed 4th fastest compared to other countries whose population size is either similar or larger than Malaysia [58], those countries that are being compared with mostly have substantial purchasing power when it comes to negotiating vaccine deals with the manufacturers. The wealthier countries are able to reserve enough doses to immunise their citizens multiple times [59]. This creates a situation where poorer countries are not able to get ample supply of vaccines soon enough to inject into their own citizens, Malaysia included. The longer the time it takes for vaccines to reach the public, the higher the chance that misleading news or remedies could manifest, which in turn affects the vaccine acceptance among the citizens. Vaccine shortages can cause the public to seek for unreliable means of treatment for the coronavirus. According to WHO [60], the public may rely on the internet and social media to obtain sensitive information regarding the management of the coronavirus, in which they will be very likely to end up with misleading information. Incidents such as Ivermectin poisoning [61] which stems from a misleading paper written by Elgazzar *et al.* [62] which proposes the effectiveness of the medication against the coronavirus could have been avoided if poorer nations got their share of COVID-19 vaccines in time. The public might also perceive traditional herbal medicines as a viable option for treating or preventing the coronavirus infection. Although several studies did found traditional medications such as traditional Chinese medicine to be effective in managing the infection [63]–[65], it is by no means the most effective method in order to achieve herd immunity. As the current standard operating procedure (SOP) [66] in Malaysia favours more towards fully vaccinated individuals, the vaccine deniers may opt for illegal route for getting around the rules and regulation. Currently, there is an increased demand of fake digital COVID-19 vaccination certificates in Malaysia [67], which the vaccine sceptics prefer to obtain rather than the vaccine itself just to get around the the COVID-19 restrictive measures.

3. RESEARCH METHOD

3.1. Study design, participants and data collection

This cross-sectional study administered an anonymous survey using a self-constructed questionnaire. The participants involved were the Malaysian public. The survey form is distributed through a COVID-19 vaccination acceptance campaign hosted on an online roadshow event, which is set out to increase COVID-19 vaccination acceptance among the Malaysian people. The campaign is advertised through Facebook using Facebook Ads. The respondents will have to fill up the questionnaire before participating in the online roadshow event. Data were collected from July 5, 2021 to August 31, 2021. A total of 794 respondents took part in the survey.

3.2. Questionnaire design

The questionnaire was designed using SurveyJS. The questionnaire collects information such as the respondents' demographic data and their perception as well as acceptance towards COVID-19 vaccines. Demographic information includes their name, email address, gender, and race. Table 1 shows the survey instrument used for this study. The first question inquires the respondents on their acceptance towards COVID-19 vaccination. The respondent can state their intention towards vaccination by choosing "Yes" or specifically state that they have already been vaccinated by choosing "I have been vaccinated", or to imply their objection towards vaccination by choosing "No". After that, the respondents are presented with a checkbox question which requires them to select all of the vaccine brands that they think are available in Malaysia. The vaccine brands listed are Pfizer, AstraZeneca, J&J, Sinovac, Sputnik V, CanSinoBIO and Moderna. Within the list of vaccine brands, both J&J and Moderna vaccines are not available in Malaysia.

Therefore, the correct answer selections for this question are Pfizer, AstraZeneca, Sinovac, Sputnik V, and CanSinoBIO. The checkbox question is then followed by three 5-point Likert scale questions that inquire the respondents' statements of agreement on the safety of the vaccine, the importance of vaccination, and the perceived confidence level for vaccines by specific manufacturers. Lastly, for the respondents that stated their objection towards vaccination, they are required to answer either "Yes", "No", or "Maybe" on their willingness to be inoculated in the future.

Table 1. Survey instrument

Questions	Answer selection
Are you willing to get COVID-19 vaccinated?	☐ Yes
	☐ No
	☐ I have been vaccinated
Do you know which of the following COVID-19 vaccines listed below are available in Malaysia?	☐ Pfizer
	☐ AstraZeneca
	☐ Johnson & Johnson
	☐ Sinovac
	☐ Sputnik V
	☐ CanSinoBIO
	☐ Moderna
I think COVID-19 vaccines (Regardless of brands) are safe. I think vaccination is important for one's health and to achieve herd immunity. I found vaccine by specific manufacturer gives lower confidence level.	☐ Strongly Agree
	☐ Agree
	☐ Neutral
	☐ Disagree
	☐ Strongly Disagree
Would you consider getting vaccinated in the future? (for those answering No for question 1).	☐ Yes
	☐ No
	☐ Maybe

3.3. Data pre-processing
The data was first extracted from a .csv file and separated by question using Python. For the checkbox question, a score will be calculated for each respondent on the total number of correct vaccine brands checked and the total number of incorrect vaccine brands unchecked. No further pre-processing is required for the Likert scale questions and the vaccination willingness questions. IBM Statistical Package for the Social Sciences (SPSS) Statistics 26 was used to do frequency analysis and descriptive analysis for the different questions respectively.

3.4. Descriptive statistics and frequency analysis
The Likert scale questions were analysed using this method. This is to estimate the overall decision by the respondents and to judge the strength of the decision made by the respondents. The checkbox question and vaccination willingness questions were analysed using this method. This is to visualize the percentage of each type of response by the respondents.

4.   RESULTS AND DISCUSSION
Table 2 shows the frequency analysis for the vaccination willingness question. Based on the results showed in Table 2, most of the respondents were willing to get vaccinated for COVID-19. The 96.8% of the respondents showed a positive reaction towards vaccination with nearly half of them (at 46.9%) have already been vaccinated. The group of respondents that was not willing to get vaccinated for COVID-19 is a minority at 3.3%. The overall statistics of the responses are presented first in Table 3, followed by the statistics for each group of respondents based on their responses towards vaccination.

Table 2. Frequency analysis for vaccination willingness

Item	n	%
Are you willing to get COVID-19 vaccinated?		
Yes	396	49.9
I have been vaccinated	372	46.9
No	26	3.3

4.1. Overall statistics

Table 3 shows the answer distribution for the Likert-scale questions answered by all the respondents. Most respondents strongly agreed (n=320, 40.3%) that COVID-19 vaccines generally are safe regardless of brands. The second majority (n=294, 37.0%) agreed on the matter but might have slight reservation on it. It is also observed that there were 14.9% of the respondents neither agree nor disagree on the safeness of the vaccines. The number of respondents that either answered 'Disagree' or 'Strongly Disagree' were significantly lesser than other answer groups at 3.7% and 4.2% of the respondents respectively.

For the question on the importance of vaccination, there was an overwhelming response in which majority of the respondents strongly agreed (n=481, 60.6%) on the matter. The number for the second majority which answered 'Agree' on the matter dropped sharply at 28% (n=222) of the respondents. The third majority of respondents which expressed neutrality on the matter were only a third of the second majority group at 57 respondents, which is 7.2% of the total respondents. There were only 3.0% and 1.3% of the respondents that answered 'Strongly Disagree' and 'Disagree' respectively.

For the question on perceived lower confidence of vaccines manufactured by specific manufacturer, the answers from the respondents were not as one-sided as the former two questions. Most respondents expressed neutrality (n=256, 32.2%) on the matter. Although a sizable number of the respondents were having neutral opinions, there were also a sizable number of them that agreed on the same topic (n=200, 25.2%). The third largest group of respondents at 17.8% (n=141) of the respondents also showed agreement on the same matter, albeit to be more strongly than the previous group, which may still have slight reservation. There were also a quite sizable number of respondents that expressed strong disagreement on having low confidence level towards vaccines manufactured by specific manufacturers. A similarly equal number of respondents (n=95, 12.0%) showed some disagreement on the matter, with a possibility of slight reservation.

Overall, it is observed that the majority of the respondents perceives that COVID-19 vaccines are safe in general, although with some of them having some reservation to fully buy into the idea (Median= 4, IQR=1). Majority of the respondents feel that vaccination is important for one's health and to achieve herd immunity (Median=5, IQR=1). When it comes to the perceived lower confidence level on vaccines manufactured by certain manufacturers, the majority of the respondents expressed neutrality on the matter (Median=3, IQR=1), although the distribution of respondents for each response was more spread out compared to the former 2 questions.

Table 3. Response analysis for likert scale questions for overall respondents

Items	n	%	Median	IQR
I think COVID-19 vaccines (Regardless of brands) are safe.				
5. Strongly agree	320	40.3	4	1
4. Agree	294	37.0		
3. Neutral	118	14.9		
2. Disagree	29	3.7		
1. Strongly disagree	33	4.2		
I think vaccination is important for one's health and to achieve herd immunity.				
5. Strongly agree	481	60.6	5	1
4. Agree	222	28.0		
3. Neutral	57	7.2		
2. Disagree	10	1.3		
1. Strongly disagree	24	3.0		
I found vaccine by specific manufacturer gives lower confidence level.				
5. Strongly agree	141	17.8	3	1
4. Agree	200	25.2		
3. Neutral	256	32.2		
2. Disagree	95	12.0		
1. Strongly disagree	102	12.8		

Table 4 shows the frequency analysis for the total correct answer for the vaccine brands selection question completed by all the respondents. More than half of the respondents at 59.3% of the sample (n=471) answered 5 out of 7 correct answers. The rest of the respondents have a spread-out distribution to each of the scoring. The second majority group that got 3 out of 7 correct answers is a huge decline (n=118, 14.9%) from the largest group. The third majority group had a roughly equal number of respondents at 12.8% of the sample (n=102) that answered 4 out of 7 correct answers. The 9.1% of the respondents, which comprises 72 individuals, were able to score 6 out of 7 correct answers. There were 16 individuals which is 2.9% of the total respondents that were only able to score 1 out of 7 correct answers.

The individuals that were able to get full marks for the checkbox question is only 1.5% of the total respondents (n=12). Lastly, only 0.4% of the sample (n=3) got 23 out of 7 correct answers.

Table 4. Vaccine brands selection question frequency analysis for overall respondents

Total correct answer	N	%
1	16	2.9
2	3	0.4
3	118	14.9
4	102	12.8
5	471	59.3
6	72	9.1
7	12	1.5
Total	794	100.0

4.2. Statistics for respondents who agree to be vaccinated

Table 5 shows the answer distribution for the Likert-scale questions answered by the respondents that showed positive feedback towards vaccination willingness. Most respondents agreed (n=155, 39.1%) on "COVID-19 vaccines in general are safe regardless of brands", while the second majority group of respondents (n=145, 36.6%) had total faith and belief in the safety of the vaccines. It is observed that the respondents have good knowledge on the impact COVID-19 vaccines have on achieving herd immunity. A big majority of the respondents strongly agreed (n=351, 56.8%) that "vaccination is important for one's health and to achieve herd immunity". The second majority of the respondents opted for "Agree" (n= 127, 32.1%), which signifies their belief in the importance of vaccines but with slight reservation. For the question on perceived lower confidence of vaccines manufactured by specific manufacture, most of the respondents were having a neutral opinion (n=135, 34.1%) on the subject of vaccines by specific manufacturers gives lower confidence level. However, all the answer types on said topic have a more balanced respondent distribution compared to the previous 2 topics. Therefore, it can be concluded that this group of respondents tends to agree on the safeness of the vaccines (Median=4, IQR=1) albeit with slight reservations and strongly believes that vaccination is important for one's health and to achieve herd immunity (Median=5, IQR=1). However, it is also observed that this group of respondents may have divided opinions (Median=3, IQR=1) when it comes to the perceived confidence level of COVID-19 vaccine produced by a certain manufacturer.

Table 5. response analysis for likert scale questions for respondents who agree to be vaccinated

Items	n	%	Median	IQR
I think COVID-19 vaccines (Regardless of brands) are safe.				
5. Strongly agree	145	36.6	4	1
4. Agree	155	39.1		
3. Neutral	68	17.2		
2. Disagree	11	2.8		
1. Strongly disagree	17	4.3		
I think vaccination is important for one's health and to achieve herd immunity.				
5. Strongly agree	225	56.8	5	1
4. Agree	127	32.1		
3. Neutral	30	7.6		
2. Disagree	2	0.5		
1. Strongly disagree	12	3.0		
I found vaccine by specific manufacturer gives lower confidence level.				
5. Strongly agree	73	18.4	3	1
4. Agree	103	26.0		
3. Neutral	135	34.1		
2. Disagree	31	7.8		
1. Strongly disagree	54	13.6		

Table 6 shows the frequency analysis for the total correct answer for the vaccine brands selection question done by the respondents that selected "Yes" in the vaccination willingness question. Based on Table 4, it is observed that the largest group of respondents at 232 individuals, or 58.6% of the sample can get 5 out of 7 correct answers. The second largest group of respondents which is a huge decline from the majority group comprises 62 individuals, or 15.7% of the sample managed to get 3 out of 7 correct answers. 11.4% of the sample can get 4 out of 7 correct answers. As there were no respondents that answered 2 out of 7 correct answers, the smallest 2 groups of respondents that can answer 7 and 1 correct answers are at 2.5%

and 1.8% respectively. This shows that while the majority of respondents that showed a positive attitude towards vaccination were able to identify most of the correct vaccine brands in Malaysia, the vaccine brands that are less administered or less well known locally may cause confusion among the respondents.

Table 6. Vaccine brands selection question frequency analysis for respondents who agree to be vaccinated

Total correct answer	n	%
1	7	1.8
2	0	0
3	62	15.7
4	45	11.4
5	232	58.6
6	40	10.1
7	10	2.5
Total	396	100.0

4.3. Statistics for vaccinated respondents

Table 7 shows the answer distribution for the Likert-scale questions answered by vaccinated respondents. Majority of the respondents either answered "Strongly Agree" (n=172, 46.2%) and "Agree" (n=131, 35.2%) when they were asked whether they think COVID-19 vaccines are safe regardless of brands. Majority of the vaccinated respondents (Median=5, IQR=1) strongly agreed that vaccination is important for one's health and to achieve herd immunity. The second majority group of respondents (n=88, 23.7%), which is a massive decrease from the majority group (n=252, 67.7%) agree on the same matter with the possibility of slight reservation. It was observed that the majority of the vaccinated respondents had neutral opinion (n=112, 30.1%) on lower perceived confidence on vaccines by certain manufacturers. The second majority group (n=92, 24.7%) indicated that they agreed on having said level of confidence towards the coronavirus vaccine. Therefore, the majority of the vaccinated respondents showed confidence in the safeness of COVID-19 vaccines (Median=4, IQR=1) and strongly agrees on the role of vaccination in maintaining one's health and to achieve herd immunity in the pandemic (Median=5, IQR=1). However, uncertainty was observed among this group of respondents with the majority of them expressing neutrality (Median=3, IQR=2) when it comes to the perceived confidence level of vaccines by specific manufacturers.

Table 7. Response analysis for likert scale questions for vaccinated respondents

Items	n	%	Median	IQR
I think COVID-19 vaccines (Regardless of brands) are safe.				
5. Strongly agree	172	46.2	4	1
4. Agree	131	35.2		
3. Neutral	46	12.4		
2. Disagree	11	3.0		
1. Strongly disagree	12	3.2		
I think vaccination is important for one's health and to achieve herd immunity.				
5. Strongly agree	252	67.7	5	1
4. Agree	88	23.7		
3. Neutral	19	5.1		
2. Disagree	7	1.9		
1. Strongly disagree	6	1.6		
I found vaccine by specific manufacturer gives lower confidence level.				
5. Strongly agree	64	17.2	3	2
4. Agree	92	24.7		
3. Neutral	112	30.1		
2. Disagree	58	15.6		
1. Strongly disagree	46	12.4		

Table 8 shows the frequency analysis for the total correct answer for the vaccine brands selection question done by the respondents that has been vaccinated. Based on Table 6, it is observed that the majority of the sample (n=231, 62.1%) were able to get 5 out of 7 correct answers. The second largest group of the respondents (n=54, 14.5%) were able to get 4 out of 7 correct answers. The third largest group of the respondents which comprises 48 respondents, which is 12.9% of the sample were able to get 3 out of 7 correct answers. 8.3% of the sample, which is 31 respondents, got 6 out of 7 correct answers. There are 2 groups that answered 3 out of 7 correct answers which are both 0.8% of the sample. Lastly, only 0.5% of the sample, which is 2 respondents, were able to get all correct answers. Similar to the group that answered "Yes" for the vaccination willingness question, although this group of respondents may already

have been vaccinated, there is also the possibility that vaccine brands that are less administered or less well known locally may cause confusion among the vaccinated respondents.

Table 8. Vaccine brands selection question frequency analysis for vaccinated respondents

Total correct answer	n	%
1	3	0.8
2	3	0.8
3	48	12.9
4	54	14.5
5	231	62.1
6	31	8.3
7	2	0.5
Total	372	100.0

4.4. Statistics for the respondents who answered "no"

Table 9 shows the frequency analysis for the Likert-scale questions answered by the respondents that showed negative feedback towards vaccination willingness. In terms of the safety aspect of COVID-19 vaccines which is shown in, this group of respondents are having mixed opinion when it comes to the safety of COVID-19 vaccines. Opinions among this group of respondents are observed to be split between "Agree" (n=8, 30.8%) and "Disagree" (n=7, 26.9%), which suggests that these groups of respondents feeling hesitant on the potential downside of getting vaccinated. It is also observed that there are equal number of respondents who strongly disagree and showing neutrality (n=4, 15.4%) on the matter. Only 11.5% of the respondents who strongly agrees that COVID-19 vaccine is safe, which makes them the minority among other respondents with different answers. This group of respondents were having mixed opinions on the importance of vaccination for one's health and to achieve herd immunity as shown in. Most individuals from this group of respondents seemed to express neutrality (n=8, 30.8%) when it comes to the importance of vaccination for one's health and to achieve herd immunity. However, a similar number of respondents (n=7, 26.9%) seems to agree on the same topic. The 19.2% of the respondents seemed to express strong disagreement. When it comes to the perceived lower confidence level of COVID-19 vaccine by specific manufacturer, many respondents opt to express neutrality (n=9, 34.6%) on this matter. The second majority of the respondents (n=6, 23.1%) disagree with the statement of perceived lower confidence of vaccines by specific manufacturers. Overall, this group of respondents showed mixed opinions on the safety of COVID-19 vaccines (Median=3, IQR=2). Furthermore, mixed opinions were also observed when it comes to the importance of vaccination to one's health and to achieve herd immunity (Median=3, IQR=2) and the perceived lower confidence level when it comes to vaccines developed by specific manufacturers (Median=3, IQR=2).

Table 10 shows the frequency analysis for the total correct answer by the respondents for the vaccine brands selection question. Based on Table 4, it is observed that the 2 largest groups of the respondents at 8 individuals, or 30.8% of the sample each answered 3 and 5 correct answers respectively. The 23.1% of the sample respondents are only able to get 1 correct answer. The minority group that answered 6 correct answers is 3.8% of the sample. None of the respondents were able to get a full score for this item.

Table 11 shows the frequency analysis for vaccination consideration in the future by the group of respondents that showed negative feedback on vaccination willingness. The respondents seemed divided on getting vaccinated for COVID-19 in the future. The 34.6% of the respondents considered getting inoculated for the coronavirus in the future, while an equal number of respondents showed hesitancy. The 30.8% of respondents rejected any consideration of vaccination in the future, signalling their assertive stance against COVID-19 vaccination.

4.5. Comparative analysis

Among all three groups of respondents, both respondents that agree to vaccination and vaccinated respondents tended to agree on the safety of vaccines, although it is observed that there might be a slight variation of answers towards "Strongly Agree" or "Neutral" among them. As for the respondents that responded negatively towards vaccination, it is observed that their opinions were much more divided compared to the other two groups of respondents. This can be seen through their answer distribution on safety of vaccines where it is much more spread out.

As for the question on importance of vaccines for one's health and to achieve herd immunity, it is clear that both respondents that agree to vaccination and vaccinated respondents have full confidence in the

importance of vaccines for one's health and to achieve herd immunity. Similar to the previous question, mixed opinions were observed among respondents that responded negatively towards vaccination where there is a variety of answers selected by them.

On the topic of lower perceived confidence towards vaccines manufactured by certain manufacturers, the respondents that agree to vaccination tended to have neutral opinions on this subject. However, there might be a slight variation of answers towards "Agree" and "Strongly Agree" among them. Both vaccinated respondents and respondents that answered negatively towards vaccination have mixed opinions on this subject. Although the answer distribution is more spread out than the aforementioned respondent group, there is still differences among both of these respondent groups. Respondents that agree to vaccination and vaccinated respondents may have slight answer variation towards "Agree" while respondents that responded negatively towards vaccination may have slight answer variation towards "Disagree".

For the vaccine brand selection question, majority of respondents that agree to vaccination and vaccinated respondents got 5 out of 7 correct answers. As for the respondents that responded negatively towards vaccination, majority of them are split between 3 and 5 correct answers. Although the result suggests that the respondents that responded negatively towards vaccination may have less knowledge on vaccine brands, the number of samples in said respondent group may be limited to make such conclusion.

Table 9. Response analysis for likert scale questions for respondents who answered "no"

Items	n	%	Median	IQR
I think COVID-19 vaccines (Regardless of brands) are safe.				
5. Strongly agree	3	11.5	3	2
4. Agree	8	30.8		
3. Neutral	4	15.4		
2. Disagree	7	26.9		
1. Strongly disagree	4	15.4		
I think vaccination is important for one's health and to achieve herd immunity.				
5. Strongly agree	4	15.4	3	2
4. Agree	7	26.9		
3. Neutral	8	30.8		
2. Disagree	2	7.7		
1. Strongly disagree	5	19.2		
I found vaccine by specific manufacturer gives lower confident level.				
5. Strongly agree	4	15.4	3	2
4. Agree	5	19.2		
3. Neutral	9	34.6		
2. Disagree	6	23.1		
1. Strongly disagree	2	7.7		

Table 10. Vaccine brands selection question frequency analysis for respondents who answered "no"

Total correct answer	n	%
1	6	23.1
2	0	0
3	8	30.8
4	3	11.5
5	8	30.8
6	1	3.8
7	0	0
Total	26	100.0

Table 11. Vaccination consideration in the future frequency analysis

Consider in the future	n	%
Yes	9	34.6
No	8	30.8
Maybe	9	34.6

5. DISCUSSION

Majority of the respondents showed that they are willing to accept a COVID-19 vaccine based on the sample. The high vaccination acceptance rate among the sample can be explained through the current economic situation in Malaysia. Since the start of the COVID-19 pandemic in Malaysia, the survivability of the Malaysian public has been significantly challenged by the ever-worsening of the local economy. Prolonged MCO will cause the sectors that were affected most by the pandemic such as tourism, manufacturing and retail, to opt for retrenchment in order to reduce losses which in turn affects employability

[68]. The increase in number of people suffering due to dwindling income and savings due to prolonged MCO [13] may cause the Malaysian public to view COVID-19 vaccination as the only way out to resolve their economic crises, as vaccination make it easier for people to return to work and increase overall economic activity [69].

Based on the study, it is observed that there are more respondents that accept vaccination compared to those rejecting it. A similar study done by Lau *et al.* [70] showed that vaccine acceptance rate among Malaysian adults were at 93.2%. Our study suggests that there is a 3.6% improvement as vaccine acceptance rate among Malaysians in our study is 96.8% with almost half of them already vaccinated. As Lau's study was done a week before Malaysia's third COVID-19 wave [71] and almost half a year before the mass COVID-19 vaccination program in February 2021 [12], it is hypothesised that prolonged MCO and the availability of vaccination programs in Malaysia has improve the general public's view and acceptance towards COVID-19 vaccines.

It is observed that the majority of the respondents that accepts vaccination generally displayed their confidence on the safety of getting inoculated. However, there are a minority of them that rejects vaccination are still somewhat divided on the same topic. Furthermore, some of the respondents that accepts vaccination still have some reservation on said matter. Their safety perception towards COVID-19 vaccine can be influenced by several factors. According to WHO [30], the efficacy number of COVID-19 vaccines is measured in a controlled clinical trial and is based on how many people who got vaccinated developed said disease, compared with how many people who got placebo developed with the same outcome. Efficacy number should not be sole indicator on the performance of the vaccine. However, numerous studies [25], [26] found that it can significantly influence the vaccination acceptance of the public. Fear towards the extreme side effects that vaccines bring might also affects the vaccination acceptance of the public. Although the possibility of getting severe side effects through COVID-19 vaccines are said to be extremely rare [33], it is still significant enough to sway the public's opinion towards vaccine hesitation [34]. A study by Tran *et al.* [72] showed that that there is a high rate of vaccine hesitancy and refusal among Vietnamese after they were informed with adverse effects of immunizations in the media. Therefore, it is important in times of a pandemic that the information of a suitable vaccine that is given to the public must not only inform them but to also not cause hesitation or agitation.

Majority of the respondents that accepts vaccination based on the sample thinks that vaccination is important for one's health and to achieve herd immunity in this pandemic. However, it is also observed that the minority who rejects vaccination may have differing opinions on the same matter. Some of the respondents that accepts vaccination still have reservations on the said topic. This phenomenon may be caused by the spread of false information on alternative methods to treat the coronavirus. There is a possibility that some of the Malaysians think they could not bear the risk of getting serious side effects from getting vaccinated, and turn to largely unproven methods such as natural remedies [41] or questionable medications [62]–[65] that may lead to serious consequences [61]. Blind faith in religion can cause the doubters to reject an antidote to this deadly pandemic, while at the same time may cause religious policymakers to make the wrong call in combatting the coronavirus [41]. In order to counter this, public health messages have to be spread around consistently especially during a pandemic. A study on the impact of media on public health awareness concerning the use of natural remedies against the COVID-19 outbreak in Saudi Arabia [73], which is also an Islamic country like Malaysia, found that the awareness videos broadcasted by the Saudi Ministry of Health had a positive effect on most of the participants in terms of changing attitudes towards natural remedies. As for vaccine rejection due to religious purposes, Galang [74] proposed the collaboration of science and religion in COVID-19 vaccine promotion, as the lack of it may undermine confidence in the vaccine which will cause confusion among the people. This is especially true in Malaysia with the majority of its citizen consists of Muslims [52] as there may be concerns for the 'halal' status of the COVID-19 vaccines.

When it comes to the respondents' opinion on the perceived lower confidence of vaccine by certain manufacturers, majority of the respondent expressed neutrality on said matter. The neutrality displayed by the respondents can be a sign of indifference towards the perceived confidence level of vaccine by different brands. Other factors such as possible side effects [34], [72] and efficacy number [25], [26] that comes with the certain brand of vaccine may influence the vaccine acceptance of the public more compared to the brand of the vaccine itself. A study done by Kreps *et al.* [75] shows that the manufacturer had no effect on vaccination attitudes among United States citizens, despite the array of controversy surrounding the vaccine manufacturer AstraZeneca [45]–[50], [76], in which the vaccine is offered in Malaysia for "first-come, first-served" basis [77]. However, the location of the vaccine manufacturer may have influence on vaccine hesitancy. A study done by Schwarzinger *et al.* [78] on COVID-19 vaccine hesitancy in a representative working-age population in France found out that the French are more hesitant towards vaccines manufactured in China compared to vaccines manufactured in the USA or EU. The neutrality of Malaysians on perceived

lower confidence of vaccines by certain manufacturers may be due to the lack of vaccine related political news surrounding Malaysia unlike in the European Union [47], [49]. However, further research into this topic is encouraged as there are still limited studies on the effect of manufacturers on perceived confidence of the vaccines that they produced around Southeast Asian countries.

In terms of vaccine brand knowledge, the majority of the respondents that accepts vaccination have better knowledge on the vaccine brands offered in Malaysia compared to the respondents that rejects vaccination. This shows that the majority of the respondents know the type of COVID-19 vaccines offered to the public. Apart from rejecting vaccination entirely, the respondents that showed rejection towards vaccination might only accept vaccines from the brand that they perceived as safer than others. There may also be the possibility of low literacy among the respondents, which studies [79], [80] have shown that it is correlated towards vaccine hesitancy.

Majority of the respondents who rejected vaccination refused to consider accepting future vaccination. However, nearly one third of the respondents who rejected vaccination considered accepting vaccination in the future. This may be due to high levels of scepticism towards the effectiveness of the vaccines that are currently offered locally. These group of respondents may have negative thoughts towards the vaccines when coming across news and media related to possible severe side effects of COVID-19 vaccines [72]. There may be a perception of poor performance if said vaccines can cause such serious side effects if it is meant to protect them against the coronavirus. Therefore, they might prefer a vaccine that has total protection against the coronavirus, with little to no side effects.

6.   CONCLUSION

This study has certain limitations. First of all, since it mainly adopts a random sampling method, the samples were both limited in number and unbalanced. There may also be the possibility that the vulnerable groups, including those with lower socioeconomic backgrounds and lower education levels were not able to take part in this study due to gadgets and internet infrastructure limitations, as well as lower literacy level. The results may not sufficiently represent the Malaysian public entirely. Furthermore, as the results obtained from this study are time dependent, results obtained here may or may not be informational for policy making or countermeasure planning.

Despite of the limitations, this study can be further elaborated to include data that allows for analyses from multiple angles. For example, the religion factor that was mentioned before can be included to understand which believer may have different opinions on accepting vaccination. Collecting data on the political compass of the participants may also give different insights on the influence of political beliefs on different groups of people on vaccination acceptance. All in all, this possible analysis can serve as a suggestion on future studies that has the same direction as this study.

Overall, based on this study, the majority of the Malaysian public have high acceptability towards COVID-19 vaccines. The findings in this study are useful to identify the possible situations or demographic of people that may have low acceptability towards not just COVID-19 vaccines, but also to any form of antidote that may be used to counter any unprecedented pandemic that may occur in the future.

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