Factors Influencing the Acceptance of COVID-19 Booster Dose in Malaysia

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Abstract

Background: This cross-sectional study aimed to identify factors influencing the acceptance of coronavirus disease 19 (COVID-19) booster dose in Malaysia based on the health belief model during 2022.

Methods: Malaysians aged 18 and above were enrolled in a cross-sectional online survey. The convenient sampling method was used for data collection, and Google form was employed as an online questionnaire, which was distributed through social media by the authors. The sociodemographic characteristics of the respondents were assessed and summarized by performing descriptive and frequency analyses. Multivariate analysis was applied to measure the associations of factors influencing the acceptance of COVID-19 booster dose among respondents in Malaysia.

Results: A total of 467 responses were analyzed in this study. Participants with neutral perceptions who think that it is easy for them to get the COVID-19 vaccine if they wanted to were 0.042 times less likely to accept COVID-19 booster dose compared to others (95% CI of 0.003- 0.556 which was significant with P<0.05 (P= 0.016). Moreover, the participants were 0.012 times more likely to be females by neutral on that it is easy for you to get the COVID-19 vaccine if you wanted to with a 95% CI of 2.166-461.040, which is significant.

Conclusion: The need for continued access to research and learning has never been more important, especially when it comes to a constantly mutating coronavirus. We also continue to work directly with agencies to support their work.

Keywords: COVID-19, Booster dose, SARS CoV-2, Vaccine acceptance, Adults, Malaysia

Introduction

In late 2019, since the emergence of severe acute respiratory syndrome coronavirus 2, which was responsible for the cause of coronavirus disease 19 (COVID-19) infections, the world has been trapped in a deadly race with a virus. The COVID-19 mitigation policies employed by various governments to control the pandemic included wearing masks, hand sanitization, self-isolation, and lockdowns. These measures slowed the massive spread of the virus but imposed nearly unbearable implications on the healthcare system and the economy. The antiviral medication remdesivir issued a conditional recommendation against its use by the World Health Organization (WHO) at the end of 2020 due to the lack of evidence regarding remdesivir’s ability to reduce COVID-19 mortality (1).

Nowadays, vaccination has become the game-changing approach that tops all other strategies to contain the COVID-19 spread. In spite of the well-known lengthy process of vaccine development, joint medical efforts between countries, institutions, and researchers have accelerated the launching of vaccines for COVID-19. Seven vaccines have been approved under emergency use authorization, as well as hundreds under clinical trials in two years (1,2). According to previous studies, protection from COVID-19 vaccine effectiveness against hospitalization and mortality rate from severe COVID-19 disease was gradually decreasing after the second dose of COVID-19 vaccines. Therefore, the importance of receiving the COVID-19 vaccine booster dose is crucial for preventing infection with new COVID-19 variants. However, the efficacy and durability of the effect of the booster dose of vaccine against the new strain of COVID-19 were controversial among scientists (3).

According to the WHO, there is a 6-month interval between the second dose and booster dose administration to increase its protection against the variants (4). Under the development of vaccination strategies, on the 28th of December 2021, the Minister of Health of Malaysia
set a three-month interval for COVID-19 booster shots for Pfizer and AstraZeneca (AZ) recipients. Based on previous literature, there were multiple factors that influenced the acceptance of COVID-19 booster dose, including age, race, gender, occupation, education status, vaccine hesitancy sentiments, and the perceptions of the population in coping the COVID-19 infection (5-8).

The National COVID-19 Immunization Program in Malaysia was started on 24th February 2021 (5). At the time of preparing this article, 76.1% of the Malaysian population fully vaccinated against COVID-19 have so far accounted for more than 24,849,925 doses; however, only one study was conducted to record the vaccine effects with the population attitude and perceptions towards COVID-19, which generalizes the study to both vaccinated and unvaccinated population, making the results unable to be fully generalized among the vaccinated population (5,7).

Although many studies have evaluated COVID-19 vaccine acceptance by the public, showing that acceptance varied globally, there are very few studies about the acceptance of the COVID-19 booster dose worldwide. This study sought to identify factors influencing the acceptance of the COVID-19 booster dose in Malaysia. The study of booster acceptance will help provide evidence to improve COVID-19 booster delivery.

Materials and Methods

Study Design
A cross-sectional study was conducted to identify factors contributing to the acceptance of COVID-19 booster dose in Malaysia in 2022.

Data Collection
An online self-administered questionnaire was distributed among the Malaysian population through Google form. Invitations were individually sent via the link through social media platforms, including Instagram, Telegram, emails, WhatsApp, and Facebook to reach the targeted sample size for quality control and respondent sincerity. Participants were given informed consent prior to enrollment in the survey. The inclusion criteria were participants who were aged 18 years and above residing anywhere in Malaysia, agreed with informed consent prior to the study enrolment, and took at least one dose of the Malaysian mandated vaccines. This kind of online questionnaire is suitable to rapidly reach a group of people during the pandemic.

Study Instrument
The questionnaire had four main sections, including sociodemographic profiles, perception of a booster dose, the willingness of accepting the COVID-19 booster dose, and source of information. Sociodemographic factors consisted of questions about age, gender, nationality, marital status, race, education level, employment status, family income per month, and residency. The additional questions asked as part of sociodemographic factors were the confirmation of healthcare workers and vaccination. This electronic questionnaire was created according to the previous literature related to the acceptance of the vaccine (2,9,10).

A pilot study was conducted to assess the validity and reliability of the questionnaire. The questionnaire was valid and reliable as the overall Cronbach alpha value was 0.726. Likewise, a similar study in Poland demonstrated good reliability as their Cronbach’s alpha value was 0.82-0.93 (8).

In our study, the Health Belief Model (HBM) was used to analyze the acceptance of the COVID-19 booster dose among the public (11). This model consists of six dimensions such as perceived susceptibility, perceived severity, perceived benefits, perceived barriers, self-efficacy, and cues to action (12).

Sample Size Determination
The sample size (n) was calculated via the Raosoft sample size calculator using a 95% confidence interval (CI) and a 5% margin of error with a population proportion of 50%. The target population size is 32.7 million consisting of fully vaccinated, partially, and booster dose vaccination status people in Malaysia (2). By taking into consideration a 20% attrition rate, the minimal sample size required in this study was 457. In this cross-sectional study, the non-probability convenience sampling technique was used to recruit the sample. The inclusion criteria included Malaysians of 18 years and older who have taken at least one dose of the Malaysian mandated vaccines, while the exclusion criteria excluded anyone under the age of 18, unvaccinated, or rather vaccinated but not by any of the Malaysian mandated vaccines.

Statistical Analysis
Statistical Package for Social Sciences (SPSS, version 26.0) was applied to analyze the data. The respondents’ sociodemographic characteristics were assessed and summarized by performing descriptive analysis and frequency analysis. Multivariate analysis was employed to measure the associations of factors influencing the acceptance of COVID-19 booster dose among respondents in Malaysia. In our study, P value less than 0.05 was considered statistically significant.

Results
According to Table 1, out of 467 respondents, most of them were in the age range of 18 to 39 years, and their mean age was 25.35 years with a standard deviation of ± 5.65. It was found that the proportion of male respondents (51.0%) is higher than that of females (49.0%), and 53.3% of them were singles. In addition, 95.3% of respondents were mostly Malaysians and belonged to the race of Indians (53.3%), had tertiary education (59.5%), and were fully employed (38.3%) with a family income group of (45.4%). The majority of the respondents have been vaccinated...
Table 1. Sociodemographic Characteristics of the Participants (N = 467)

| Variables                     | Frequency (N) | Percent |
|-------------------------------|---------------|---------|
| Age                           |               |         |
| Young adults (18-39)          | 300           | 64.2    |
| Middle adults (40-59)         | 119           | 25.5    |
| Older adults (≥60)            | 48            | 10.3    |
| Gender                        |               |         |
| Male                          | 238           | 51.0    |
| Female                        | 229           | 49.0    |
| Marital status                |               |         |
| Single                        | 249           | 53.3    |
| Married                       | 187           | 40.0    |
| Divorced                      | 16            | 3.4     |
| Widowed                       | 14            | 3.0     |
| Others                        | 0             | 0       |
| Nationality                   |               |         |
| Malaysian                     | 445           | 95.3    |
| Non-Malaysi                  | 22            | 4.7     |
| Race                          |               |         |
| Malay                         | 116           | 24.8    |
| Chinese                       | 73            | 15.6    |
| Indian                        | 249           | 53.3    |
| Others                        | 29            | 6.2     |
| Education level               |               |         |
| No formal education           | 10            | 2.1     |
| Primary                      | 6             | 1.3     |
| Secondary                    | 40            | 8.6     |
| Post-secondary (Pre-university, matriculation, A-level, diploma, foundation, and the like) | 133 | 28.5 |
| Tertiary (Bachelor, Degree, Master, and PhD) | 278 | 59.5 |
| Employment status             |               |         |
| Employed (full time)          | 179           | 38.3    |
| Employed (part time)          | 47            | 10.1    |
| Unemployed                    | 9             | 1.9     |
| Retired                       | 51            | 10.9    |
| Student                       | 158           | 33.8    |
| Others                        | 23            | 4.9     |
| Family income per month       |               |         |
| <RM 4849 (B40)                | 212           | 45.4    |
| RM 4850 – RM 10960 (M40)      | 194           | 41.5    |
| >RM 10960 (T20)               | 61            | 13.1    |
| Residency                     |               |         |
| Urban                         | 385           | 82.4    |
| Rural                         | 82            | 17.6    |
| Are you a healthcare worker?  |               |         |
| Yes                           | 103           | 22.1    |
| No                            | 364           | 77.9    |
| Are you vaccinated?           |               |         |
| First dose                    | 3             | 0.6     |
| Second dose                   | 255           | 54.6    |
| Booster dose                  | 209           | 44.8    |
| Not vaccinated                | 0             | 0       

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Until the second dose (54.6%). Table 2 presents HBM factors; based on the results, 49.3% of respondents had an extremely high risk of the COVID-19 infection and agreed (44.9%) to the higher risk of the COVID-19 infection from a variant than from the existing strains; further, 52.2% of them agreed with the high severity of COVID-19 infection and agreed (50.3%) to more severe illness caused by variants compared with the existing strains. The findings revealed that 47.3% of respondents believed in the high efficacy of the booster against early circulating strains, a booster to extend protection (49.5%), and a booster against variants (46.0%); in addition, they perceived high (47.3%) safety of COVID-19 boosters and were neutral (36.0%) worried about serious adverse reactions after vaccination. Moreover, they agreed (42.2%) that it would be easy to get the COVID-19 vaccine if wanted. Additionally, they (54.8%) confirmed or suspected cases in daily close contacts and strongly agreed (52.7%) to know at least one foreign variant. Finally, most of them would accept (92.5%) COVID-19 booster if it is recommended as a supplement to the current vaccination schedule.

According to data in Table 3, 55.0% of participants strongly agreed and received sufficient information about the COVID-19 booster dose; however, 0.9% of them strongly disagreed with that statement. In this regard, news media affected their decisions on whether to receive the COVID-19 booster dose (38.5%, 10.7%, and 17.1% agreed, strongly agreed, and disagreed, respectively). Similarly, 32.1% of participants were neutral on family and friends’ opinions affecting their decisions of whether to receive the COVID-19 booster dose, while 25.5% disagreed with that statement. The obtained data (Table 4) further demonstrated that male participants were 0.42 times more willing to accept the COVID-19 booster dose compared to female participants (95% CI: 0.217-1.038) with a P-value less than 0.05, which is significant. Participants with a family income group of M40 were 0.044 times less likely to accept the COVID-19 booster dose in comparison to the T20 group, which is significant beyond a P-value less than 0.05 (95% CI: 0.015-1.123). The Omnibus Tests of Model Coefficients yielded a chi-square of 51.78 on 25 df, which is significant beyond 0.001. Therefore, adding variables mentioned in Table 4 could improve the model.

Based on data in Table 5, under perceived susceptibility, most of the participants agreed that the risk of COVID-19 infection is less likely to be high compared to having an extremely low risk of COVID-19 infection (95% CI: 0.018-0.641) with a P value less than 0.05, which is significant. Participants agreed that it is 0.043 times more likely for variants to have a higher risk of infection than the existing strains compared to those who strongly agree with that statement (95% CI: 1.053-31.461), which is significant as the P value is less than 0.05. Under the self-efficacy of HBM, the majority of the participants disagreed 0.001 times less likely easy to get the COVID-19 vaccine if wanted compared to those who strongly disagreed with it (95% CI: 0.005-0.289), which is significant since the
Table 2. Perceptions and Willingness of COVID-19 Booster Vaccination Acceptance Based on the Health Belief Model (N=467)

| Variables | Frequency (N) | Percent |
|-----------|---------------|---------|
| **Perceived Susceptibility** | | |
| Risk of COVID-19 infection | | |
| Very high | 230 | 49.3 |
| High | 208 | 44.5 |
| Neutral | 25 | 5.4 |
| Low | 4 | 0.9 |
| Very low | 0 | 0 |
| Variants have higher risk of infection than the existing strains | | |
| Strongly agree | 202 | 43.3 |
| Agree | 233 | 49.9 |
| Neutral | 28 | 6 |
| Disagree | 3 | 0.6 |
| Strongly disagree | 0 | 0 |
| **Perceived Severity** | | |
| Severity of COVID-19 | | |
| Very high | 194 | 41.5 |
| High | 244 | 52.2 |
| Neutral | 24 | 5.1 |
| Low | 4 | 0.9 |
| Very Low | 0 | 0 |
| Variants can cause more severe illness than the existing strains | | |
| Strongly agree | 197 | 42.2 |
| Agree | 235 | 50.3 |
| Neutral | 31 | 6.6 |
| Disagree | 3 | 0.6 |
| Strongly disagree | 0 | 0 |
| **Perceived Benefits** | | |
| Efficacy of boosters against early circulating strains | | |
| Very high | 176 | 37.7 |
| High | 221 | 47.3 |
| Neutral | 58 | 12.4 |
| Low | 7 | 1.5 |
| Very low | 5 | 1.1 |
| Efficacy of boosters to extend protection | | |
| Very high | 169 | 36.2 |
| High | 231 | 49.5 |
| Neutral | 59 | 12.6 |
| Low | 5 | 1.1 |
| Very low | 3 | 0.6 |
| Efficacy of boosters against variants | | |
| Very high | 173 | 37.0 |

Table 2. Continued

| Variables | Frequency (N) | Percent |
|-----------|---------------|---------|
| High | 215 | 46.0 |
| Neutral | 63 | 13.5 |
| Low | 13 | 2.8 |
| Very low | 3 | 0.6 |
| **Perceived Barriers** | | |
| Safety of boosters | | |
| Very high | 173 | 37.0 |
| High | 221 | 47.3 |
| Neutral | 57 | 12.2 |
| Low | 10 | 2.1 |
| Very low | 6 | 1.3 |
| Worry about serious adverse reactions after vaccination | | |
| Very high | 47 | 10.1 |
| High | 157 | 33.6 |
| Neutral | 168 | 36.0 |
| Low | 61 | 13.1 |
| Very low | 34 | 7.3 |
| **Self-efficacy** | | |
| It is easy to get the COVID-19 vaccine if wanted | | |
| Strongly agree | 85 | 18.2 |
| Agree | 197 | 42.2 |
| Neutral | 154 | 33.0 |
| Disagree | 28 | 6.0 |
| Strongly disagree | 3 | 0.6 |
| **Cues to Action** | | |
| Used to have confirmed or suspected cases in daily close contacts | | |
| Yes | 256 | 54.8 |
| No | 211 | 45.2 |
| Know about at least one foreign variant | | |
| Strongly agree | 246 | 52.7 |
| Agree | 180 | 38.5 |
| Neutral | 32 | 6.9 |
| Disagree | 4 | 0.9 |
| Strongly disagree | 5 | 1.1 |
| **Willingness of Accepting COVID-19 Booster Dose** | | |
| If a COVID-19 booster is recommended as a supplement to the current vaccination schedule, would you accept it? | | |
| Yes | 432 | 92.5 |
| No | 35 | 7.5 |

Note. COVID-19: Coronavirus disease 19.
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Table 3. Source of Information Regarding COVID-19 Booster Dose (N = 467)

| Variables                                      | Frequency (N) | Percent |
|------------------------------------------------|---------------|---------|
| I have received sufficient information about COVID-19 booster dose. |               |         |
| Strongly agree                                 | 257           | 55.0    |
| Agree                                          | 148           | 31.7    |
| Neutral                                        | 43            | 9.2     |
| Disagree                                       | 15            | 3.2     |
| Strongly disagree                              | 4             | 0.9     |
| News media affected the decision of whether to receive the COVID-19 booster dose. |               |         |
| Strongly agree                                 | 50            | 10.7    |
| Agree                                          | 180           | 38.5    |
| Neutral                                        | 146           | 31.3    |
| Disagree                                       | 80            | 17.1    |
| Strongly disagree                              | 11            | 2.4     |
| Family and friends’ opinions affected my decision on whether to receive the COVID-19 booster dose. |               |         |
| Strongly agree                                 | 36            | 7.7     |
| Agree                                          | 125           | 26.8    |
| Neutral                                        | 150           | 32.1    |
| Disagree                                       | 119           | 25.5    |
| Strongly disagree                              | 37            | 7.9     |

Note: COVID-19: Coronavirus disease 19.

P value is less than 0.05. The Omnibus Tests of Model Coefficients represented a chi-square of 140.569 on 37 df, which is significant beyond 0.001. Therefore, adding the mentioned variables (Table 5) could improve the model.

According to the obtained data (Table 6), Participants with neutral perceptions who think that it is easy for them to get the COVID-19 vaccine if they wanted to were 0.042 times less likely to accept COVID-19 booster dose compared to others (95% CI of 0.003-0.556) with $P < 0.05$ ($P = 0.016$). Female participants who had neutral perception on that it is easy to get COVID-19 vaccine if they wanted to were 0.012 times less likely to accept COVID-19 booster dose compared to male participants which was significant with $P < 0.05$. Eventually, the participants were 0.034 times less likely to receive the second dose of COVID-19 vaccination by strongly agree on that the variant of COVID-19 has a higher risk of infection than the existing strains with a 95% CI of 0.124-2.049, which is significant since the $P$ value is less than 0.05.

Sensitivity of this study was 99.3% which implied that if they were female who had neutral perception on that it is easy to get COVID-19 vaccine if they wanted to and those who received second dose of COVID-19 vaccine who strongly agreed that the variant of COVID-19 had a higher risk of infection than the existing strains had 99.3% chance of willingness to accept COVID-19 booster dose. The specificity of 45.7%, which meant that if you were male by not neutral on that it is easy for you to get the COVID-19 vaccine if you wanted to and you received COVID-19 vaccination other than the second dose by not strongly agreeing that the variant of COVID-19 has a higher risk of infection compared to the existing strains; there was 45.7% chance of not willing to accept COVID-19 booster dose. However, overall, our prediction was correct out of 467 times for an overall success rate of 95.3%. According to Hosmer and Lemeshow test, since the $P$ value was 0.995 (more than 0.05) and not significant, the data set fits well with the logistic model.

In this study, Cox and Snell’s R-squared was 0.234. Thus, 23.4% of the willingness of accepting COVID-19 booster dose was explained by participants who were neutral on that it is easy for you to get the COVID-19 vaccine if you wanted to, who were female participants by neutral on that it is easy for you to get the COVID-19 vaccine if you wanted to and you received the second dose of COVID-19 vaccination by strongly agree that the variant of COVID-19 has a higher risk of infection than the existing strains.

The Nagelkerke R-squared was obtained as 0.566. It implied that there were 56.6% relationship between the willingness of accepting COVID-19 booster dose with those participants who had neutral perception on that it is easy for them to get COVID-19 vaccine if they wanted to, female participants those were neutral perception on that it is easy for them to get the COVID-19 vaccine if they wanted to and those received the second dose of COVID-19 vaccination who strongly agreed on that variant of COVID-19 have a higher risk of infection than the existing strains. Based on the result of the omnibus test of model coefficients, a chi-square of 124.288 was obtained on 35 df, which is significant beyond 0.001. Therefore, adding variables mentioned in Table 6 could improve the model. For checking the outliers, we had to save Cook’s influential statistics; the cut-off point for Cook’s influential statistics was 1.0. In our data, none was more than 1.0. Therefore, there were no influential outliers in our study.

According to the ROC curve (Figure 1), the models discriminated 95.0% (95% CI: 92.5-97.4) of the predicted willingness to accept the COVID-19 booster dose.

Discussion

This research was performed roughly four months after the implementation of the National COVID-19 Immunization Program in Malaysia. Malaysia had undergone 4 waves with the latest variant by date of this article being the Omicron variant, which became a dominant variant with an increase of sequence COVID-19 cases from 0.25% to 4% and rapidly escalated to 65% in just one month (8). In our research, 64.2% of our respondents were 18-39 years of age and participated in this survey, which aimed to measure their sociodemographic characteristics, perception, and willingness with regard to accepting COVID-19 booster vaccination based on the HBM (13). It was found that 92.5% of the respondents who participated in our survey were willing to accept the COVID-19 booster dose if
Table 4. Association Between Sociodemographic Variables on the Willingness to Accept COVID-19 Booster Dose in Malaysia Using Simple Logistic Regression (N = 467)

| Variable | B     | Wald  | df | Crude Odds Ratio | 95% CI (Lower) | 95% CI (Upper) | P-value |
|----------|-------|-------|----|------------------|----------------|----------------|---------|
| Age      |       |       |    |                  |                |                |         |
| Young adults (18-39) | -1.007 | 0.621 | 1  | 0.365            | 0.030          | 4.467          | 0.431   |
| Middle adults (40-59) | -1.333 | 1.347 | 1  | 0.264            | 0.028          | 2.504          | 0.246   |
| Older adults ≥ 60 | ref   |       |    |                  |                |                |         |
| Gender   |       |       |    |                  |                |                |         |
| Male     | -0.745| 3.486 | 1  | 0.475            | 0.217          | 1.018          | 0.042   |
| Female   | ref   |       |    |                  |                |                |         |
| Marital status |       |       |    |                  |                |                |         |
| Single   | -15.487 | 0.000 | 1  | 0.000            | 0.000          | -              | 1.000   |
| Married  | -14.988 | 0.000 | 1  | 0.000            | 0.000          | -              | 1.000   |
| Divorced | 3.004  | 0.000 | 1  | 20.170           | 0.000          | -              | 1.000   |
| Widowed  | -15.869 | G7.000 | 1  | 0.000            | 0.000          | -              | 1.000   |
| Others   | ref   |       |    |                  |                |                |         |
| Nationality |       |       |    |                  |                |                |         |
| Malaysian | -18.227 | 0.000 | 1  | 0.998            | 0.000          | -              | 0.998   |
| Non-Malaysian | ref   |       |    |                  |                |                |         |
| Race     |       |       |    |                  |                |                |         |
| Chinese  | -17.818 | 0.000 | 1  | 0.000            | 0.000          | -              | 0.998   |
| Indian   | -18.757 | 0.000 | 1  | 0.000            | 0.000          | -              | 0.998   |
| Malay    | -17.437 | 0.000 | 1  | 0.000            | 0.000          | -              | 0.998   |
| Others   | ref   |       |    |                  |                |                |         |
| Education level |       |       |    |                  |                |                |         |
| No formal post-secondary | 19.825 | 0.000 | 1  | 407157733.2      | 0.000          | -              | 0.999   |
| Primary  | 0.309  | 0.515 | 1  | 1.362            | 0.586          | 3.170          | 0.473   |
| Secondary | 18.113 | 0.000 | 1  | 73487334.82      | 0.000          | -              | 0.999   |
| Tertiary | ref   |       |    |                  |                |                |         |
| Employment status |       |       |    |                  |                |                |         |
| Employed | -17.900 | 0.000 | 1  | 0.000            | 0.000          | -              | 0.999   |
| Others   | -19.212 | 0.000 | 1  | 0.000            | 0.000          | -              | 0.999   |
| Retired  | -17.764 | 0.000 | 1  | 0.000            | 0.000          | -              | 0.999   |
| Student  | -18.201 | 0.000 | 1  | 0.000            | 0.000          | -              | 0.999   |
| Unemployed | ref   |       |    |                  |                |                |         |
| Family income per month |       |       |    |                  |                |                |         |
| < RM 4849 (B40) | -0.641  | 0.362 | 1  | 0.511            | 0.057          | 4.555          | 0.548   |
| RM 4850 – RM 10960 (M40) | -2.041  | 3.441 | 1  | 0.130            | 0.015          | 1.123          | 0.044   |
| > RM 10960 (T20) | ref   |       |    |                  |                |                |         |
| Residency |       |       |    |                  |                |                |         |
| Rural    | 0.097  | 0.035 | 1  | 1.102            | 0.401          | 3.026          | 0.851   |
| Urban    | ref   |       |    |                  |                |                |         |
| Are you a healthcare worker? |       |       |    |                  |                |                |         |
| No       | -0.668 | 1.197 | 1  | 0.513            | 0.155          | 1.697          | 0.274   |
| Yes     | ref   |       |    |                  |                |                |         |
| Are you vaccinated? |       |       |    |                  |                |                |         |
| Booster dose | 1.122  | 5.542 | 1  | 3.070            | 1.207          | 7.813          | 0.019   |
| First dose | 18.101 | 0.000 | 1  | 726.783          | 0.000          | -              | 0.999   |
| Second dose | ref   |       |    |                  |                |                |         |
| Not vaccinated | -   | -     | -  | -                | -              | -              | -       |

Note: COVID-19: Coronavirus disease 19; CI: Confidence interval.
Table 5. Association Between Perception Based on the Health Belief Model and Willingness to Accept COVID-19 Booster Dose Using Simple Logistic Regression (N = 467)

| Variable | B     | Wald  | df | P-value | Crude Odds Ratio | 95% CI       |
|----------|-------|-------|----|---------|-----------------|--------------|
|          |       |       |    |         |                 |              |
|          |       |       |    |         |                 |              |
|          |       |       |    |         |                 |              |
|          |       |       |    |         |                 |              |
| Risk of COVID-19 infection |       |       |    |         |                 |              |
| High     | -2.225| 6.002 | 1  | .014    | 0.108           | 0.018 - 0.641|
| Low      | -1.754| 0.742 | 1  | .389    | 0.173           | 0.003 - 9.372|
| Neutral  | -1.363| 0.722 | 1  | .395    | 0.256           | 0.011 - 5.928|
| Very high| -      | -     | 1  | -       | -               | -             |
| Very low | -      | -     | 1  | -       | -               | -             |
| Variants have higher risk of infection than the existing strains |       |       |    |         |                 |              |
| Strongly disagree | - | - | 1 | - | - | - |
| Agree    | 1.750 | 4.079 | 1  | .043    | 5.756           | 1.053 - 31.461|
| Disagree | 15.898| 0.000 | 1  | 0.999   | 8023738.601     | 0.000 - .    |
| Neutral  | 0.695 | 0.197 | 1  | 0.657   | 2.003           | 0.093 - 43.063|
| Strongly agree | - | - | 1 | - | - | - |

| Perceived Susceptibility |

| Severity of COVID-19 |       |       |    |         |                 |              |
|----------------------|-------|-------|----|---------|-----------------|--------------|
|                      |       |       |    |         |                 |              |
|                      |       |       |    |         |                 |              |
|                      |       |       |    |         |                 |              |
| High                 | -15.756| 0.000 | 1  | 1.000   | 0.000           | 0.000 - .    |
| Low                  | 80.129 | 0.000 | 1  | 0.999   | 63028.000       | 0.000 - .    |
| Neutral              | -13.197| 0.000 | 1  | 1.000   | 0.000           | 0.000 - .    |
| Very high            | -15.323| 0.000 | 1  | 1.000   | 0.000           | 0.000 - .    |
| Very low | - | - | 1 | - | - | - |
| Variants can cause more severe illness than the existing strains |       |       |    |         |                 |              |
| Agree               | 1.594 | 3.107 | 1  | 0.078   | 4.926           | 0.836 - 29.005|
| Disagree            | 39.591| 0.000 | 1  | 0.999   | 156345229024875392.000 | 0.000 - .    |
| Neutral             | 0.094 | 0.004 | 1  | 0.948   | 1.099           | 0.066 - 18.318|
| Strongly agree | - | - | 1 | - | - | - |
| Strongly disagree   | - | - | 1 | - | - | - |

| Perceived Benefits |

| Efficacy of boosters against early circulating strains |       |       |    |         |                 |              |
|-------------------------------------------------------|-------|-------|----|---------|-----------------|--------------|
|                                                      |       |       |    |         |                 |              |
|                                                      |       |       |    |         |                 |              |
| High                                                 | -22.061| 0.000 | 1  | 1.000   | 0.000           | 0.000 - .    |
| Low                                                  | -4.710 | 0.000 | 1  | 1.000   | 0.009           | 0.000 - .    |
| Neutral                                              | -20.233| 0.000 | 1  | 1.000   | 0.000           | 0.000 - .    |
| Very high                                            | -22.007| 0.000 | 1  | 1.000   | 0.000           | 0.000 - .    |
| Very low | - | - | 1 | - | - | - |
| Efficacy of boosters to extend protection |       |       |    |         |                 |              |
|                                                      |       |       |    |         |                 |              |
|                                                      |       |       |    |         |                 |              |
| High                                                 | 56.688 | 0.000 | 1  | .998    | 4160.000        | 0.000 - .    |
| Low                                                  | 35.068 | 0.000 | 1  | .998    | 1607.200        | 0.000 - .    |
| Neutral                                              | 54.049 | 0.000 | 1  | .998    | 2972.000        | 0.000 - .    |
| Very high                                            | 57.974 | 0.000 | 1  | .998    | 1506.000        | 0.000 - .    |
| Very low | - | - | 1 | - | - | - |
| Efficacy of boosters against variants |       |       |    |         |                 |              |
|                                                      |       |       |    |         |                 |              |
|                                                      |       |       |    |         |                 |              |
| High                                                 | 63.771 | 0.000 | 1  | 0.999   | 4929.000        | 0.000 - .    |
| Low                                                  | 42.144 | 0.000 | 1  | 0.999   | 2009.000        | 0.000 - .    |
| Neutral                                              | 61.138 | 0.000 | 1  | 0.999   | 3562.000        | 0.000 - .    |
| Very high                                            | 62.595 | 0.000 | 1  | 0.999   | 1530.000        | 0.000 - .    |
| Very low | - | - | 1 | - | - | - |
recommended as a supplement to the current vaccination schedule. This response recorded in our research may have been influenced by the government’s decision of shortening the interval of boosted dose administration from six to three months for Pfizer and AstraZeneca COVID-19 vaccine recipients, and this was due to the emerging Omicron threat (14).

Approximately 7.5% of the respondents are still unsure of accepting booster vaccination (15). This statement would be further investigated with how protection against the new circulating strains is associated with the willingness to accept. The main obstacle affecting their

Table 5. Association Between Sociodemographic Characteristics and Perception With the Willingness of Accepting COVID-19 Booster Dose Using Multiple Logistic Regression (N = 467)

| Variable                                                                 | B                | Wald  | df | P-value | Crude Odds Ratio | 95% CI          |
|-------------------------------------------------------------------------|------------------|-------|----|---------|------------------|-----------------|
| Safety of boosters                                                      |                  |       |    |         |                  |                 |
| High                                                                    | -18.383          | 0.000 | 1  | 0.999  | 0.000            | 0.000           |
| Low                                                                     | -21.826          | 0.000 | 1  | 0.999  | 0.000            | 0.000           |
| Neutral                                                                | -18.689          | 0.000 | 1  | 0.999  | 0.000            | 0.000           |
| Very high                                                               | -19.333          | 0.000 | 1  | 0.999  | 0.000            | 0.000           |
| Very low**                                                              | -                | -     |    |         | -                | -               |
| Worry about serious adverse reaction after vaccination                  |                  |       |    |         |                  |                 |
| High                                                                    | 1.121            | 1.496 | 1  | 0.221  | 3.069            | 0.509           |
| Low                                                                     | 2.377            | 3.221 | 1  | 0.073  | 10.768           | 0.803           |
| Neutral                                                                | 1.461            | 2.391 | 1  | 0.122  | 4.309            | 0.677           |
| Very low                                                                | -                | -     |    |         | -                | -               |
| Very high**                                                             | -                | -     |    |         | -                | -               |
| It is easy to get the COVID-19 vaccine if wanted                        |                  |       |    |         |                  |                 |
| Agree                                                                   | 0.642            | 0.410 | 1  | 0.522  | 1.900            | 0.266           |
| Disagree                                                                | -3.229           | 10.131 | 1  | 0.001  | 0.040            | 0.005           |
| Neutral                                                                | 0.233            | 0.071 | 1  | 0.790  | 1.263            | 0.226           |
| Strongly agree                                                          | -                | -     |    |         | -                | -               |
| Strongly disagree**                                                     | -                | -     |    |         | -                | -               |
| Used to have confirmed or suspected cases in daily close contacts       |                  |       |    |         |                  |                 |
| No                                                                      | -0.337           | 0.299 | 1  | 0.585  | 0.714            | 0.213           |
| Yes**                                                                  | -                | -     |    |         | -                | -               |
| Know about at least one foreign variant                                 |                  |       |    |         |                  |                 |
| No                                                                      | 0.925            | 0.358 | 1  | 0.550  | 2.521            | 0.122           |
| Yes**                                                                  | -                | -     |    |         | -                | -               |

Note. COVID-19: Coronavirus disease 19; CI: Confidence interval.
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A study conducted in China aiming at evaluating the willingness to accept COVID-19 booster dose among adults in Malaysia. Note: COVID-19: Coronavirus disease 19.

Prior studies reported that the effectiveness of vaccines is one of the important characteristics associated with the willingness of accepting the vaccine (15,26) Similarly, perceived barriers played a significant role where previous studies highlighted the vaccination for COVID-19, and it was pointed out that close surveillance should be organized on the development of booster vaccination (16,27).

Our study was conducted based on the HBM, and it was proven that perceived susceptibility (95% CI: 0.018-0.641) and self-efficacy (P < 0.05) played an important role in the acceptance of the COVID-19 booster dose. As for the previous research in China, their findings revealed that perceived barriers (95% CI: (0.13-0.35) and perceived benefits (95% CI: 0.81-2.10) to vaccination were essential dimensions associated with the acceptance of COVID-19 boosters. However, perceived severity (P=1.00), benefits (P=1.00), barriers (P=0.99), and cues to action (P=0.59) were not significant predictors in our research (2,25).

Figure 1. ROC Curve to Discriminate Between Those Having Willingness to Accept COVID-19 Booster Dose and Those not having Willingness to Accept COVID-19 Booster Dose Among Adults in Malaysia. Note: COVID-19: Coronavirus disease 19.

The test result variable(s): Predicted probability has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased.

a. Under the nonparametric assumption
b. Null hypothesis: True area=0.5

| Area | Std. Error | Asymptotic Sig. | Asymptotic 95% Confidence Interval | Lower Bound | Upper Bound |
|------|------------|----------------|-----------------------------------|-------------|-------------|
| .950 | .012       | 000            | 0925                              | .974        |

Diagonal segments are produced by ties.
had participants aged 41-50 with higher education levels demonstrated significantly a lower booster acceptance rate, while employed or those prioritized for vaccination had higher booster acceptance (2,9). The relationship between sociodemographic characteristics and acceptance of the booster dose in this research provides preliminary results that would help shed light on the availability of COVID-19 booster doses and the risk of infection with the existing strains (9).

Additionally, more than 55% of them strongly agreed that they have received sufficient information about the COVID-19 booster. The Malaysian Ministry of Health has played a great part in being transparent while battling the pandemic by supplying sufficient and latest information to the general public. They have accomplished this by three vastly used platforms, including the Official Portal of the Ministry of Health, official Facebook, and Telegram accounts where they provided numerous infographics related to COVID-19 (22). In Jordan, 49.3% of participants were familiar with receiving the booster dose and 50.5% of them agreed to have previous knowledge of mixed vaccination programs (1,10). In addition, 38.5% of our participants agreed that news media affected their decisions of whether to receive the COVID-19 booster whereas 32.1% had a neutral opinion on the same statement. It is mentioned that during this pandemic, there has been a spike in misinformation about COVID-19 vaccines and their boosters by anti-vaxxers (11,24). To combat this, the Malaysian government has encouraged its people to always check the veracity of the COVID-19-related information with Sebenarnya, which is a portal created by the Malaysian Communications and Multimedia Commission (MCMC) or they can provide reports to MCMC itself (11,25,26).

There are several limitations that should be stressed in our research. Considering that this was a cross-sectional online survey, there are possibilities for some intrinsic weaknesses. There could be the existence of sampling bias in order to limit the representativeness of the possible outcome (12,20,21). This study attempted to reduce bias by finding a wide range of adult participants by the stratified sampling method. Moreover, in self-reported responses, there might have been recalling bias and a tendency to provide socially inclined responses. To reduce this bias, we conducted this study anonymously which would have enabled respondents to answer without any burdens. We hope future studies on this topic have more accuracy in order to avoid biases found in our research.

Conclusion
Overall, our research preliminarily identified a large group of participants willing to accept COVID-19 boosters in Malaysia. Furthermore, the study highlighted the need for joined-up solutions to end the pandemic, including the important role of international development assistance to support developing countries. This research could be used as a guide in Malaysia and other countries in measuring factors influencing the COVID-19 booster dose acceptance in order to provide the public with better protection against the novel coronavirus.

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Conflict of Interests
There was no conflict of interests in this study.

Ethical Permissions
All the participants were provided with informed consent before the commencement of the survey. The ethical approval was acquired from the Centre of Research and Development, Asia Metropolitan University (HEC022022FOM0002), which was in accordance with the Declaration of Helsinki.

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