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A survey on Malaysian's acceptance and perceptions towards COVID-19 booster dose

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ABSTRACT

Progressive reopening of the economy and declaration of COVID-19 as endemic has relaxed social distancing and mask-wearing necessities in Malaysia. The Ministry of Health of Malaysia reported vaccination rate had reached 86.1% for the first dose and 84.3% for the second dose as of April 2023. However, the uptake of booster doses (third dose or fourth dose) is relatively lower at 68.6% and 1.5%, respectively. A cross-sectional survey was undertaken to study the acceptance and perception of Malaysians towards booster doses in Peninsular Malaysia with participants 18 years old and above by distributing questionnaires at public areas such as government offices, major city train stations, and airports. The study included elderly participants who were not technology savvy. Of 395 survey respondents, 69.4% accepted the COVID-19 booster dose. The results showed that smartphone usage ($p = 0.019$), living area ($p = 0.049$), and education level ($p = 0.006$) significantly influenced the perception of booster dose acceptance among socio-demographic characteristics. Despite experiencing side effects from previous vaccination, 65.9% of respondents still opted to receive booster doses ($p = 0.019$). The highest deciding factor in accepting booster dose was the need for more clinical studies on COVID-19 booster dose (58.2%) ($p = 0.045$). In conclusion, the survey demonstrates that greater emphasis on updating and providing more clinical studies regarding the need for booster doses will increase the public's acceptance of the COVID-19 booster dose.

1. Introduction to Coronavirus disease and COVID-19 vaccines

Coronavirus disease (COVID-19) is a severe acute respiratory infection initially reported in Wuhan, Hubei Province, China. The disease has spread rapidly worldwide since December 2019. There had been 761,402,282 cumulative cases and 761,402,282 cumulative deaths worldwide as of March 29, 2023, affecting 224 countries (WHO, 2023). The infectious agent of COVID-19 is a novel encapsulated (+)RNA virus from the Coronaviridae family named SARS-CoV-2 by the World Health Organisation (WHO). The virus SARS-CoV-2 contains almost 80% similarity in sequence identity (SI) with SARS- CoV (SARS pandemic, 2002 – 2003) and 50% SI with MERS-CoV (MERS pandemic, 20120) (Lu et al., 2020). Mimicking the SARS-CoV, the l spike protein of SARS-CoV-2 binds to the angiotensin-converting enzyme 2 (ACE-2) receptor on the surface of various human cells such as intestinal epithelial, alveolar tissue, neuroepithelial cells and endothelial cells. Systemic symptoms of COVID-19 included cough, fever, acute respiratory distress (ARD), diarrhoea and fatigue. However, there were also brain oedema, partial neurodegeneration and encephalitis reported in severe COVID-19 patients. (Reza-Zaldívar et al., 2020) COVID-19 infection has been categorised into five stages according to severity by the Ministry of Health, Malaysia (Reza-Zaldívar et al., 2020). In Malaysia, the cumulative cases had reached 5,047,040 cases and 36,972 cumulative deaths as of March 29, 2023.

The COVID-19 virus lineage is currently named using three nomenclature systems: GISAID, Nextstrain and Pango (World Health Organization, 2021). For ease of communication for the

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public and non-scientific community, different variants are referred to with Greek alphabets such as Alpha, Beta, Gamma, Delta, Omicron, Lambda, Mu, Epsilon, Zeta, Theta, Iota, Eta, and Kappa. These variants are further classified into Variants of concern (VOC), Variants of interest (VOI) and Variants being monitored (VBM). The Technical Advisory Group on Virus Evolution under the WHO consistently monitors the amino acid profile of the different variants and evaluates the risk possessed to the global population. Based on the risk, it will be reclassified into VOI, VOC or VBM by the Centers for Disease Control and Prevention (CDC) (World Health Organization, 2021). Due to the high spread ability of COVID-19, WHO issued an Emergency Use Listing (EUL) for several COVID-19 vaccines to reduce the infectivity rate and severity of infection in mass vaccination programmes, which started in December 2020. As of January 2022, there are 9 COVID-19 vaccines under the EUL: (i) Pfizer/BioNTech Comirnaty issued on December 31, 2020; (ii) SII/COVIDSHIELD and AstraZeneca/AZD1222 vaccines, issued on February 16, 2021; (iii) Janssen/Ad26.CoV 2.S, issued on March 12, 2021; (iv) Moderna COVID-19 vaccine, issued on30th April 2021; (v) Sinopharm COVID-19 vaccine, issued on May 7, 2021; (vi) Sinovac CoronaVac, issued on June 1, 2021; and (vii) Bharat Biotech BBV152 COVAXIN vaccine issued on November 3, 2021 (viii) Covovax (NVX-CoV2373) vaccine issued on December 17, 2021 (ix) Nuvaxovid (NVC-Cov2373) vaccine issued on December 20, 2021 (World Health Organization, 2019).In August 2022, Malaysia recorded about 3,000 cases daily, with a national positivity rate of about 8.4%. Hospital bed utilisation due to COVID-19 cases was reported to be 24.8% for standard beds, 14.4% for intensive care unit (ICU) beds and 20.6% for quarantine centres. At this point, 68.6% of the adult population in Malaysia has received their 1st COVID-19 booster dose, and 1.5% have received their second booster dose (Ying, 2022). Most Malaysians were reported to be less vigilant in masking up during this period (Dermawan, 2022). Entry of the new Omicron XBB sub-variant was recorded by the Ministry of Health, Malaysia, in October 2022, and by November 2022, Malaysia recorded more than 20,000 new cases daily. However, only 4.6% were hospitalised, 0.2% were admitted to ICU, and no cases were reported to be admitted in the quarantine centre. 95.2% of 34,609 cases were home quarantined (Bernama, 2022). At the end of December 2022, newer variants, such as the BA.5.2 variant and BF.7 variant, were present; however, these numbers did not lead to a rise in mortality (Hibrahim, 2022). Towards the end of the survey data collection in January, the COVID-19 cases were reduced to less than 400 cases daily, and only 19 patients required treatment in ICU facilities nationwide (Star, 2022). In April 2023, a rise in COVID-19 cases was detected, where the number of reported cases surged from 2,000 to more than 3,000 per day (Yusry, 2023).

Data from the Ministry of Health of Malaysia shows the vaccination rate has reached 86.1% for the first dose and 84.3% for the second dose from the total population as of April 2023. The vaccination rate for the third dose or first booster is 50.0%. Meanwhile, only 2.5% of the vaccination rate was achieved as of April 2023 (Ministry of Health Malaysia, 2023). Although the global fatality rate of COVID-19 recorded was comparatively lower than other infectious diseases such as SARS-CoV, Ebola and MERS-CoV, the infectious rate of COVID-19 is much higher than those stated (Mathieu et al., 2019). The mutation of the COVID-19 virus also causes a surge in new infections. Currently, newer variants such as Omicron are creating a new wave making the situation difficult for recovery from the pandemic. In March 2023, a new Omicron subvariant wave, Arcturus or XBB1.16, was detected in Malaysia (Ganesan, 2023). Arcturus is reported to be 1.2 times more transmissible than other Omicron sub-variant and Delta variants (Ganesan, 2023; Sulaiman, 2023). Due to this, the COVID-19 vaccine booster dose is required for high-risk groups in Malaysia (Abhilash et al., 2022). This situation has created a different reaction from the public, where some refused to take booster doses and were concerned about mixing vaccines for booster doses due to fear of severe side effects. There are also ongoing discussions about the need for a second booster dose of the COVID-19 vaccine.

As of Oct 2022, the lowest vaccination rate below 80% are recorded in the states on East Coast on Peninsular (Pahang, Terengganu, Kelantan) and Sabah in East Malaysia region where vaccine hesistancy in this regions could be correlated with a few factors (Ministry of Health, 2022).Vaccine hesitancy has been a global issue for quite a while, the main triggering factors are confidence, convenience issues, and complacency (MacDonald, 2015). According to a study conducted on vaccine hesitancy in East Malaysia, groups with high vaccine hesitancy are; Muslim respondents and participants with low education (Jafar et al., 2022). Knowledge, education and vaccine hesitancy of adults may also impact the vaccinations to the younger ones. For instance this is shown in a study in Italy where parents who have knowledge on the disease vaccinated their children (Della Polla et al., 2020). In another study in Canada, vaccine hesitancy among mothers was strongly associated with intention to vaccinate their infacts (Dubé et al., 2019). Previous study in Malaysia reported 11.6% of parents to be vaccine hesitant (Mohd Azizi et al., 2017). Experts in Malaysia suggest the government study real-world data before implementing a second booster dose in the endemic phase (FMT, 2022; Yusof, 2022). Previous surveys were conducted online on the perception and acceptance of COVID-19 booster doses. They did not capture sufficient information from the population who are not technology savvy, the elderly population, groups with lower income and the suburban population (Alwi et al., 2021; Elnaem et al., 2021; Marzo et al., 2022a, 2022b; Mohamed et al., 2021; Wong et al., 2023; Wong et al., 2022). Hence, further studies are needed to understand Malaysians' perceptions, acceptance, and concerns before implementing an additional booster dose. The current study explores the following association: -

a) Socioeconomic, demographic, geographic location, and comorbidities correlate with the public's perception and acceptance towards the administration of COVID-19 booster doses in Malaysia.
b) Side effects from previous COVID-19 vaccination correlate with the public's perception and acceptance towards the administration of COVID-19 booster doses in Malaysia.

1.1. Methodology

This cross-sectional survey was conducted on the Malaysian population through random convenience sampling where participants were recruited at areas of public interest such as bus stops, train stations, airports, and government offices with a self-administered questionnaire in locations throughout Peninsula Malaysia. The location was chosen based on the availability of time among members of the public. Meanwhile, members of the public completed the questionnaire while waiting for service in the government office or for the arrival of a bus, train or flight Initially, the survey was a pilot study with 30 respondents, followed by a complete survey with 395 respondents. No amendments were made to the survey questions used in the pilot study; therefore, the respondents were included in the final survey. The survey questionnaire aimed to assess the public's perception of the administration of booster doses and the side effects experienced by respondents from previous COVID-19 vaccinations. Ethical approval (UM.TNC 2/UMREC) was obtained from the University of Malaya Research Ethics Committee (UMREC). The survey form was only passed to those willing to participate and gave their verbal consent. The survey respondents were provided with a physical

consent form on the first page of the questionnaire to seek agreement that feedback provided is voluntary and data collected in the survey is only available to principal investigators and confidential to others. The questionnaire took approximately 10 min to be completed by each participant, and there was no follow-up post-collection of the physical questionnaire form from the participants. No monetary reward or gift was provided to respondents for participation in the survey.

1.2. Study area, timeline, and population

The study was conducted for six months, from August 1, 2022 to January 20, 2023, in areas of public interest with a self-administered questionnaire. The study was planned to be conducted throughout Peninsular Malaysia. As per the Department of Statistics Malaysia (DOSM) demographic statistics in 2020, more than 32 million people have been reported (Department of Statistics Malaysia, 2021a). Therefore, the sampling was done among respondents who consented to be part of the study population.

i) Inclusion criteria: Malaysian national aged eighteen years old and above.
ii) Exclusion criteria: Those with language barrier, difficulties in reading and writing, impaired vision and physical disabilities which prevented the participation in the survey.

1.3. Study design

A random convenience sampling design approach was adopted, and data was collected from the Malaysian community. A cross-sectional survey was conducted in areas of public interest with a self-administered questionnaire throughout Peninsula Malaysia.

1.4. Sample size

The sample size was calculated using the Raosoft software sample size calculator with the following formula.

$$x = Z(c/100)^2 r(100 - r)$$

$$n = Nx/((N-1))E^2 + x$$

$$E = \mathrm{Sqrt}[(N-n)x/n(N-1)]$$

where N is the population size, r is the fraction of responses aimed and Z(c/100) is the critical value for the confidence level, c.(Raosoft, 2004).

The margin of error is 5%, with a confidence level of 95%. The population size used in the calculation was 32 600 000, with a response distribution of 50%. The recommended sample size for the study was 385 adults and at the end of the sample collection, there were 415 individuals approached with 395 completing the survey. The attrition rate of the study was 4.8%.

1.5. Sampling method and tools

The sampling tool consisted of a newly designed 29 -questions survey titled: A Survey on COVID-19 Booster Vaccine Acceptance and Side Effects from previous administration on Malaysian population which went through reliability testing (Cronbach's Alpha) and validity testing (Delphi technique). The questionnaire was developed based on previous research on COVID-19 vaccine acceptance in Malaysia and globally (Lau et al., 2021; Reno et al., 2021). The limitation of previous studies was considered, and questions were adapted and modified. The questionnaire comprises five sections as follows: -

Section (A) Demographic and Socioeconomic Background of Respondents; which included questions on gender, marital status, age, race, educational level, occupation, household income range, living area, ability to use smart phone, previous history of illness and COVID-19 infection.

Section (B) Information about COVID-19 vaccination; which included questions on previous COVID-19 vaccination history and type of COVID-19 vaccine received according to first, second, and booster dose vaccination.

Section (C) Side effects from COVID-19 vaccination; which included questions on side effects experienced from previous vaccination according to first, second and booster dose administration, and information pertaining reporting of side effect to the regulatory agency.Participants who did not experience any previous side effect skipped from answering questions in this section.

Section (D) Acceptance of COVID-19 booster dose; which included questions on willingness to accept subsequent booster dose, preference for homologous or heterologous vaccination, recommendation of booster dose to immediate family members, and deciding factor for acceptance or rejection for a booster dose.

Section (E) Perception about COVID-19 vaccination; which included questions on factors which increases confidence and likelihood to accept COVID-19 vaccine.

2. Data analysis

The data were analysed using Statistical Package for Social Science version 22. Appropriate statistical analysis was performed using a 95% confidence interval or $p < 0.005$. Descriptive analysis, such as mean and standard deviation, was used on continuous data; meanwhile, the nominal data were described using frequency and percentages in the demographic section. In order to look for the relationship between the categorical variable and chi-square test were performed. A simple logistic regression was performed to determine the effect of subsequent COVID-19 booster dose acceptance with covariates.

3. Results

3.1. Demographic and baseline characteristics

Out of 415 approached subjects, a total of 395 respondents participated in this survey, bringing the response rate of 95.2%. In this survey, male respondents were higher than female respondents (52.9% vs 47.1%) (Table 1). As of 2020, the Population in Malaysia is more than 32 million, and as per different gender, males have outnumbered females (52.3% vs 47.7%). The response by gender breakdown in this survey is similar to the national population (Department of Statistics Malaysia, 2021a). The married population appears to be the largest, with 65.1%, followed by 21.0% unmarried, 6.1% widowed and 7.8% divorced among the survey respondents. Similarly, according to the 'Population and Housing Census of Malaysia 2020′ (MyCensus 2020), the highest group per marital status consisted of 58.5% married population followed by 35.8% unmarried, 4.0% widowed and 1.7% divorced (Department of Statistics Malaysia, 2023). In this survey conducted, the highest number of respondents appear to be from the age group between 30 and 39 years old (25.6%), followed by the age group 50 to 59 (17.2%), 40 to 49 years old (16.7%), 60 to 69 years old (15.4%), 20 to 29 years old (13.9%), 70 years old and above (11.1%). The Department of Statistics Malaysia also released the data for the population in 2020 according to age group. The data showed the highest population falls in the age group between 30 and 39 years

Table 1
Socio-demographic characteristics, COVID-19 vaccination history and information based on side effects experienced by survey respondents (n = 395) from previous COVID-19 vaccine administration.

Socio-demographic and other characteristics	Frequency (Percentage)
Gender	
Male	209(52.9)
Female	186(47.1)
Marital status	
Single	83(21.0)
Married	257(65.1)
Divorced	31(7.8)
Widowed	24(6.1)
Age range	
20–29	55(13.9)
30–39	101(25.6)
40–49	66(16.7)
50–59	68(17.2)
60–69	61(15.4)
70 and over	44(11.2)
Race	
Malay	305(77.2)
Chinese	53(13.4)
Indian	32(8.1)
Others	5(1.3)
Education level	
Below high school, e.g. SPM/SPM(V) qualification	43(10.9)
High school, e.g. SPM, SPM(V) & equivalent	59(14.9)
Certificate/TVET (Technical and vocational education)	22(5.6)
Diploma/ STPM or equivalent (College)	117(29.6)
Bachelor/advanced diploma or equivalent	145(36.7)
Postgraduate (Master/PhD)	9(2.3)
Occupation	
Unemployed / Retired	60(15.2)
Executive / Administrator, e.g. Supervisors, managers, directors, C-level executives e.g. CEO, CFO, COO & etc	161(40.7)
Skilled workers, e.g. Engineers, Teachers, Doctors, Lawyers	87(22.0)
Semi-skilled workers, e.g. Clerks, Mechanics, Plumbers, Electricians	17(4.3)
Labourer	69(17.5)
Self-employed	1(0.3)
Sector	
Government	107(27.1)
Private/Own Business	224(56.7)
Not Applicable/Relevant	64(16.2)
Monthly Household Income	
Below RM2,500.00	58(14.7)
RM2,501.00 - RM4,849.00	156(39.5)
RM4,850.00 - RM10,959.00	152(38.5)
Above RM10,960.00	29(7.3)
Living Area	
Urban	325(82.3)
Sub-Urban	68(17.2)
Rural	2(0.5)
Postcode (state)	
Perlis	3(0.75)
Kedah	19(4.8)
Penang	36(9.1)
Kelantan	19(4.8)
Terengganu	12(3.0)
Pahang	15(3.8)
Perak	55(13.9)
Selangor	122(30.9)
Wilayah Persekutuan Kuala Lumpur	64(16.2)
Negeri Sembilan	9(2.3)
Malacca	24(6.1)
Johor	13(3.3)
Sabah	1(0.3)
Sarawak	3(0.75)
Smart Phone Usage	
Yes	357(90.4)
No	38(9.6)
Illness/Disease	
Healthy individual	179 (45.3)
Obesity	43(10.9)
Cancer	9(2.3)
Chronic kidney disease	2(0.5)
Cardiovascular disease	27(6.8)
Diabetes mellitus	52(13.2)
Pulmonary disease	3(0.8)

Table 1 (*continued*)

Socio-demographic and other characteristics	Frequency (Percentage)
Autoimmune disease	2(0.5)
Two comorbidities	44 (11.1)
Three or more comorbidities	34 (8.6)
Previous infection with COVID-19	
Suspected symptoms but did not verify with doctor/RT-PCR examination	15(3.8)
No	71(18.0)
Yes (no symptoms)	127(32.1)
Yes (mild symptoms – fever, cough, and fatigue)	116(29.4)
Yes (moderate symptoms – difficulty breathing or mild pneumonia)	35(8.9)
Yes (severe symptoms – severe pneumonia, organ failure)	6(1.5)
Yes (Hospitalised or Low-Risk Quarantine and Treatment Centre)	25(6.3)
Type of 1st COVID vaccine	
Pfizer BioNTech	223(56.4)
Astra-Zeneca	64(16.2)
Sinovac	107(27.1)
Cansino	1(0.3)
COVID-19 vaccine received	
Administered one dose	4(1.0)
Administered two dose	16(4.1)
Administered three dose	373(94.4)
No	2(0.5)
Type of 2nd COVID vaccine	
Pfizer BioNTech	227(57.5)
Astra-Zeneca	60(15.2)
Sinovac	108(27.3)
Type of booster vaccine	
Did not receive COVID-19 booster dose	58(14.7)
Pfizer BioNTech	212(53.7)
Astra-Zeneca	28(7.1)
Sinovac	97(24.5)
Side effects from previous vaccination	
Experienced side effects from the first vaccine dose administration	84(21.3)
Experienced side effects from the second vaccine dose administration	13(3.3)
Experienced side effects from first and second vaccine dose administration	222(56.2)
Did not experience any side effect	76(19.2)
Have you reported your side effects through the "MySejahtera" mobile application or the NPRA website?	
Not applicable	72(18.3)
Yes	168(42.5)
No	155(39.2)
If not, why have you not reported it?	
Not applicable	239(60.5)
I am not technology savvy	43(10.9)
I feel the process is complicated	11(2.8)
I did not know I could report my side effects through "MySejahtera" or the NPRA website	48(12.1)
I forgot to report the side effects I have experienced.	27(6.8)
I did not feel like reporting the side effects I experienced.	18(4.6)
I did not see the importance of reporting the side effects I have experienced.	9(2.3)

old (18.6%) followed by those 20 to 29 years old (16.4%),40 to 49 years(13.0%),50 to 59 years old (8.9%), 60 to 69 years old (5.4%), 70 years and above recorded the lowest in the demographic (2.95%). The representation of the elderly group seems higher than the actual population. At the same time, this addresses the gap or limitation from previous studies that did not include a sufficient Elderly Population (Alwi et al., 2021; Lau et al., 2021; Wong et al., 2022). The ethnicity spread among respondents found that Malay respondents (77.2%), Chinese (13.4%), Indian (8.1%) and others (1.3%). According to My Census 2020, the Population of Malaysia is divided into multiple ethnicities consisting of 69.4% Bumiputera population, Chinese (23.2%), Indian (6.7%) and others (0.7%) (Department of Statistics Malaysia, 2023). In comparison with the ethnicity spread among respondents, Malay respondents (77.2%), Chinese (13.4%), Indian (8.1%) and others (1.3%). The racial composition of survey respondents is almost similar to the actual composition, whereby the Malay population is reported to be the highest.

By education, most of the respondents possess an education level bachelor, advanced diploma or equivalent (36.7%), followed by a diploma or equivalent (29.6%). Meanwhile, others possess high school or college qualifications (14.9%), certificates (14.9%), and postgraduate qualifications (2.3%). The survey shows that graduates' representation was higher than those who qualified with high school certificates or equivalent. The Graduates' Statistics 2020 reported that 5.36 million graduates in Malaysia made up more than 16% of the population. Those with certificates from polytechnics, colleges, universities, or recognised bodies are defined as graduates. From these numbers of graduates, about 68.8% are working in skilled category occupations and 31.2% in semi-skilled or low-skilled occupations (Department of Statistics Malaysia, 2021c). As of 2022, the labour force in Malaysia was estimated to be more than 16.6 million (Department of Statistics Malaysia, 2022c). The labour force survey included the employment structure and details of those employees who fall in the age group of 15 to 64 years (Department of Statistics Malaysia, 2022b). From this number, the size of civil service in Malaysia provides more than 1.6 million jobs (Povera, 2021). Meanwhile, jobs in the private sector, as of the year 2020, involved more than 8.4 million persons. The semi-skilled job classification had the highest share of 62.4% or 5.2 million jobs. They were followed by the skilled category (2.0 million) jobs and the low-skilled occupation

category (1.1 million) jobs. Most of the employees were found to be employed in the services sector, with more than 4.3 million jobs (Department of Statistics Malaysia, 2021b). The survey respondents were mostly found to be executives and administrators (40.7%), followed by skilled workers (22.0%), labourers (17.5%), unemployed or retired (15.2%), and the remaining 4.3% were semi-skilled workers. Most of the respondents worked in the private sector (56.7%), followed by the government (27.1%) and those who were unemployed or retired fall into the not applicable classification which constitutes about 16.2%. This survey sees a good representation of private sector employees however falls short in representation of semi-skilled workers in comparison with employment statistics in Malaysia.

The monthly household income of survey respondents was highest in the range of RM2,501 to RM4,849 (39.5%), followed by RM4,850 to RM 10,959 (38.5%), below RM2,500 (14.7%) and above RM10,960 (7.3%). The household income survey (HIS) conducted by the Department of Statistics, Malaysia, in 2019 showed that there are about 2.91 million households who fall in the B40 classification (earning from RM2,501 to RM4,849), 2.91 million households in M40 (earning from RM4,850 to RM10,959) and 1.46 million households in T20 group (earning more than RM10,960) in Malaysia (Department of Statistics Malaysia, 2020). The poor households earning below RM2,500 was estimated to be 0.4 million in population for the same year (Department of Statistics Malaysia, 2021d). This comparison shows the composition of respondents by household income range have almost similar composition of B40 and M40 Malaysian representation; however, representation from the poor households and lesser representation from the T20 income group. The respondents are 82.3% residing in urban areas, 17.2% in sub-urban areas and 0.5% in rural areas. The respondents are from the states of Selangor (30.9%) followed by Wilayah Persekutuan Kuala Lumpur (16.2%), Perak (13.9%), Penang (9.1%), Kedah (4.8%), Kelantan (4.8%) and remaining other states which constitutes for 20.3% in cumulative. Key findings from the population and housing census of Malaysia 2020 state that 24.4 million people (75.1%) live in urban areas, and 8.1 million (24.9%) live in rural areas (Department of Statistics Malaysia, 2022a). Therefore, there is a lack of representation from the rural community. The ability to use a smartphone among respondents was reported to be 90.4%. Meanwhile, according to the information and communication technology use report and access by individuals and households survey 2021, smartphone usage in Malaysia was reported to be 98.7%. (Department of Statistics Malaysia, 2021e).

3.2. Previous COVID-19 vaccination history and side effects from previous vaccination

From the data (Table 1), the majority of respondents (57.5%)received Pfizer BioNTech, followed by 27.3% who received Sinovac. Of 395 respondents, 85.4% received a third or first booster dose. From the total number of survey respondents, 80.8% experienced side effects from the first or second doses of vaccine administration. Post-vaccination with Pfizer vaccine, 191 (59.7%) respondents experienced side effects, 79 (24.7%) experienced side effects with Sinovac and 49 (15.31=%) experienced side effects cases with Astra-Zeneca. In this survey, 42.5% of respondents reported their side effects through the 'MySejahtera' mobile application or the National Pharmaceutical Regulatory Agency (NPRA) website. For those who did not report the side effects, 12.2% of respondents did not know that the side effects can be reported on the 'MySejathera' mobile application and NPRA website, 10.9% are not technology savvy, 6.8% forgot to report the side effects they have experienced and 9.7% not favourable in reporting the side effects due to other reasons as per listed in Table 1.

3.3. Acceptance of COVID-19 booster dose vaccination

Table 2 shows that 69.4% of respondents were willing to consider either the first or second booster dose. Among the respondents, 75.9% were willing to accept the booster if there was no compulsion from the government. Most respondents (37.0%) preferred heterologous vaccination, followed by 26.3% preferred homologous methods for booster dose vaccination. Besides that, willingness to recommend booster dose administration (81.5%) for their immediate family members, such as children and elderly parents, was also high among respondents.

Table 3 shows that most respondents in the age group between 20 and 29 years old had higher acceptance (81.8%)($p = 0.08$) towards booster dose vaccination. Additionally, participants with tertiary education had an acceptance rate above 70% ($p = 0.006$). Participants in the urban area had a higher acceptance rate (72.0%) ($p = 0.049$) towards COVID-19 booster doses. Those who are able to use smartphones also had a high acceptance rate towards booster dose (92.7%) ($p = 0.019$). Participants who had received the first booster dose had a high acceptance rate (70.5%) ($p = 0.019$) towards subsequent booster doses. Higher acceptance rates for COVID-19 booster doses (84.0%) ($p = 0.024$) were also seen among those who did not experience any side effects after administering the first and second COVID-19 shots, as shown in Table 4. Despite experiencing side effects from the previous first and second COVID-19 shots, 65.8% of respondents were still willing to receive the first or second booster dose ($p = 0.024$).

3.4. Factors affecting acceptance of COVID-19 booster dose

As shown in Table 5, the highest deciding factor for the acceptance of booster dose was the need for more clinical studies on COVID-19 booster dose (58.2%). The respondents also opted for more updates and information from the government (52.2%) and halal certification (42.5%) on the vaccines. The most common reason cited for refusing the vaccine was "I was concerned about side effect" (27.3%), "I did not think the vaccine was safe" (26.8%) and "I did not think there was enough information on the vaccine" (23.8%). Moreover, 65.6% of participants also chose "The vaccine does not cause any immediate or long-term injury" as the most important factor to make them more confident in subsequent COVID-19 booster shots. Another important factor cited by 71.4% of the respondents to increase the likelihood of booster dose acceptance was "Once vaccinated, I will be able to live my life with no restrictions".

Table 2
Acceptance of COVID-19 booster dose vaccination.

Questions on acceptance of COVID-19 booster dose.	Frequency (Percentage)
Would you consider to obtain a subsequent COVID-19 booster dose (3rd OR 4th dose if there is one)?	
Yes	274(69.4)
No	121(30.6)
Would you consider receiving the booster dose if there is no compulsion from the government?	
Yes	300(75.9)
No	95(24.1)
Which type of booster dose would you prefer?	
Similar to 1st and 2nd dose (Homologous vaccine)	104(26.3)
Different compared to 1st and 2nd dose (Heterologous vaccine)	146(37.0)
No preference	145(36.7)
Would you recommend booster dose administration for your immediate family members, e.g. children and elderly parents?	
Yes	322(81.5)
No	73(18.5)

Table 3
Association of socioeconomic, demographic, geographical location, comorbidities, previous infection of COVID-19 and side effects from previous vaccination with acceptance of COVID-19 booster dose among the public.

Would you consider obtaining a subsequent COVID-19 booster dose (3rd OR 4th dose if there is one)?	Yes	No	P value
Gender			
Male	147 (70.3)	62 (29.7)	0.733
Female	127 (68.3%)	59 (31.7)	
Marital status			
Single	60 (72.3)	23 (27.7)	0.270
Married	177 (68.9)	80 (31.1)	
Divorced	24 (77.4)	7 (22.6)	
Widowed	13 (54.2)	11 (45.8)	
Age range			
20–29	45 (81.8)	10 (18.2)	0.080
30–39	66 (65.4)	35 (34.6)	
40–49	43 (65.2)	23 (34.8)	
50–59	51(75.0)	17 (25.0)	
60–69	44 (72.1)	17 (27.9)	
Race			
Malay	214 (70.2)	91 (29.8)	0.905
Chinese	36 (67.9)	17 (32.1)	
Indian	21 (65.6)	11 (34.4)	
Others	3 (60.0)	2 (40.0)	
Education level			
Below high school, e.g. SPM/SPM(V) qualification	23 (53.5)	20 (46.5)	0.006
High school eg SPM, SPM(V) & equivalent	44 (74.6)	15 (25.4)	
Certificate/TVET (Technical and vocational education)	10 (45.5)	12 (54.5)	
Diploma/ STPM or equivalent (College)	84 (71.8)	33 (28.2)	
Bachelor/advanced diploma or equivalent	104 (71.7)	41 (28.3)	
Postgraduate (Master/PhD)	9 (100)	0	
Occupation			
Unemployed/Retired	38 (63.3)	22 (36.7)	0.676
Executive/Administrator CEO, CFO, COO & etc	111 (68.5)	51 (31.5)	
Skilled workers	59 (67.8)	28 (32.2)	
Semi-skilled workers	14 (82.3)	3 (17.7)	
Labourer	51 (73.9)	18 (26.1)	
Self-employed	1 (100)	0	
Sector			
Government	72 (67.3)	35 (32.7)	0.581
Private/Own business	160 (71.4)	64 (28.6)	
Not applicable	42 (65.6)	22 (34.4)	
Monthly household income			
Below RM2,500	34 (58.6)	24 (41.4)	0.244
RM2,501 – RM 4,849	112 (71.8)	44 (28.2)	
RM4,850 – RM 10,959	106 (69.7)	46 (30.3)	
RM10,960 and above	22 (75.9)	7 (24.1)	
Living Area			
Urban	234 (72.0)	91 (28.0)	0.049
Sub-urban	39 (57.4)	29 (42.6)	
Rural	1 (50.0)	1 (50.0)	
Postcode/State			
Perlis	3 (100)	0	0.904
Kedah	12 (63.2)	7 (36.8)	
Penang	25 (69.4)	11 (30.6)	
Kelantan	14 (73.7)	5 (26.3)	
Terengganu	9 (75.0)	3 (25.0)	
Pahang	11 (73.3)	4 (26.7)	
Perak	39 (71.0)	16 (29.0)	
Selangor	80 (65.6)	42 (34.4)	
W.P Kuala Lumpur	45 (70.3)	19 (29.7)	
Negeri Sembilan	8 (88.9)	1 (11.1)	
Malacca	15 (62.5)	9 (37.5)	
Johor	9 (69.2)	4 (30.8)	
Sabah	1 (100)	0	
Sarawak	3 (100)	0	
Smartphone usage			
Yes	254 (92.7)	20 (7.3)	0.019
No	103 (85.1)	18 (14.9)	
Illness/Disease			
Healthy	129 (72.1)	50 (27.9)	0.019
Obesity	34 (79.1)	9 (20.9)	
Cancer	5 (55.6)	4 (44.4)	
Chronic kidney disease	2 (100)	0	
Cardiovascular disease	21 (77.8)	6 (22.2)	
Diabetes mellitus	28 (53.8)	24 (46.2)	
Pulmonary disease	3 (100)	0	
Autoimmune disease	2 (100)	0	

(*continued on next page*)

Table 3 (*continued*)

Would you consider obtaining a subsequent COVID-19 booster dose (3rd OR 4th dose if there is one)?	Yes	No	P value
Two comorbidities	33 (75.0)	11 (25.0)	
Three or more comorbidities	17 (50.0)	17 (50.0)	
Previous infection with COVID-19			
Suspected symptoms but did not verify with doctor/RT-PCR examination	8 (53.3)	7 (46.7)	0.685
No	48 (67.6)	23 (32.4)	
Yes (no symptoms)	87 (68.5)	40 (31.5)	
Yes (mild symptoms, fever, cough and fatigue)	81 (69.8)	35 (30.2)	
Yes (moderate symptoms – difficulty breathing or mild pneumonia)	28 (80.0)	7 (20.0)	
Yes (severe symptoms – severe pneumonia, organ failure)	4 (66.7)	2 (33.3)	
Yes (Hospitalised or Low-Risk Quarantine and Treatment Centre)	18 (72.0)	7 (28.0)	
COVID-19 vaccine received			
Administered one dose	4 (100)	0	0.019
Administered two doses	6 (37.5)	10 (62.5)	
Administered three doses	263 (70.5)	110 (29.5)	
No	1 (50.0)	1 (50.0)	
Type of 1st COVID vaccine			
Pfizer BioNTech	158 (70.8)	65 (29.2)	0.548
Astra-Zeneca	40 (62.5)	24 (37.5)	
Sinovac	75 (70.1)	32 (29.9)	
Cansino	1 (100)	0	
Type of 2nd COVID vaccine			
Pfizer BioNTech	163 (71.8)	64 (28.2)	0.184
Moderna	0	1 (100)	
Astra-Zeneca	36 (61.0)	23 (39.0)	
Sinovac	75 (69.4)	33 (30.6)	
Side effects from previous vaccination			
Experienced side effects from the first vaccine dose administration	56 (65.9)	29 (34.1)	0.024
Experienced side effects from the second vaccine dose administration	9 (69.2)	4 (30.8)	
Experienced side effects from first and second vaccine dose administration	146 (65.8)	76 (34.2)	
Did not experience any side effect	63 (83.0)	13 (17.0)	

Table 4
Association between previous side effects profile with types of vaccine and factors of public acceptance towards COVID-19 booster dose.

	Experienced side effects from the first vaccine dose administration	Experienced side effects from the second vaccine dose administration	Experienced side effects from first and second vaccine dose administration	Did not experience any side effect	P value
Type of COVID-19 vaccine					
Pfizer BioNTech	48	8	135	35	1st dose
Moderna	0	0	1	0	(0.129)
Astra-Zeneca	13	0	36	13	2nd dose
Sinovac	24	5	50	27	(0.299)
Cansino	0	0	0	0	
Total	85	13	222	75	1st dose & 2nd dose (0.299)
Willingness to accept subsequent COVID-19 booster dose (First or second booster dose)					
Yes	56 (65.9)	9 (69.2)	146 (65.8)	63 (84.0)	0.024
No	29 (34.1)	4 (30.8)	76 (34.2)	12 (16.0)	
Willingness to receive the booster dose if there is no compulsion from the government					
Yes	61 (71.8)	10 (76.9)	167 (75.2)	62 (82.7)	
No	24 (28.2)	3 (23.1)	55 (24.8)	13 (17.3)	0.434
Willingness to recommend booster dose administration for your immediate family members eg. children and elderly parents					
Yes	65 (76.5)	11 (84.6)	176 (80.0)	70 (94.6)	
No	20 (23.5)	2 (15.4)	44 (20.0)	4 (5.4)	0.211

Table 6 displays the simple logistic regression analysis applied to demographic factors. The results in this analysis showed that better acceptance towards the COVID-19 booster dose was observed in sub-urban dwellers (OR = 0.39; 95% CI 0.02–6.28), rural (OR = 0.74; 95% CI 0.05–12.39), those who experienced a side effect from second vaccine administration (OR = 2.72; 95% CI 1.27–5.83), those who experienced a side effect from first and second vaccine administration (OR = 2.33; 95% CI 0.62–8.82), and those who did not experience from any side effect (OR = 2.73; 95% CI 1.389–5.377). When a multivariate regression was performed on acceptance of subsequent COVID-19 booster dose (first or second booster), side effects from previous vaccination (p = 0.036) and education level (p = 0.006) were significant.

4. Discussion

The present study aimed to evaluate the perception of booster dose among Malaysians and the side effect profile of previous COVID-19 vaccinations through a survey and found that 69.4% of respondents were willing to accept either the first or second booster dose. In the current study, 65.9% of respondents who previously encountered side effects from the previous COVID-19 vaccination are still keen to obtain the booster dose. The younger age group, 20 to 29 years old, had the highest acceptance rate of 81.82%. Meanwhile, an Italian study found that among the majority, 85.7% were willing to accept a COVID-19 booster dose. Among those respondents, older adults are reportedly more willing to

Table 5
Factors affecting acceptance of COVID-19 booster dose.

Deciding factor in accepting or rejecting a booster dose	**Chose one option (n = 395)**	**Chose two options (n = 388)**	**Chose three options (n = 318)**	**Chose four options (n = 148)**
More clinical studies on the need for booster COVID-19.	223 (56.5)	3(0.8)	2(0.6)	2(1.4)
Number of adverse reaction cases from the administration of the COVID-19 vaccine.	82 (20.7)	70(18.0)	0	0
More updates and information from the government.	53(13.4)	117(30.2)	36(11.3)	0
Halal certification.	22(5.6)	79(20.4)	52(16.4)	15(10.1)
Government orders booster dose mandatory to retain fully vaccinated status.	11(2.8)	58(14.9)	75(23.6)	13(8.8)
Effectiveness towards newer COVID-19 variants.	3(0.8)	43(11.1)	78(24.5)	25(16.9)
Side effect due to previous administration	1(0.2)	10(2.6)	29(9.1)	24(16.2)
The preferred type of vaccine was not given as a booster dose.	0	6(1.5)	31(9.8)	36(24.3)
Not confident over booster dose.	0	1(0.25)	12(3.8)	22(14.9)
Side effects experienced by friends/ relatives.	0	1(0.25)	3(0.9)	11(7.4)
Reasons for refusing a vaccine in the past that a healthcare worker recommended.	**Chose one option (n = 395)**	**Chose two options (n = 196)**	**Chose three options (n = 152)**	**Chose four options (n = 26)**
Never refused a vaccine recommended by a healthcare worker.	223(56.5)			
Did not think it was needed.	82(20.8)	4(2.0)		
Did not have enough information on the vaccine.	53(13.4)	38(19.4)	3(2.0)	
Did not think the vaccine was effective.	22(5.6)	45(23.0)	23(15.1)	1(3.9)
Did not think the vaccine was safe.	11(2.8)	62(31.6)	30(19.7)	3(11.5)
Concerned about side effects.	3(0.7)	38(19.4)	54(35.5)	13(50.0)
Bad experience with a previous vaccination	1(0.2)	7(3.6)	33(21.7)	7(26.9)
Did not know where to get a vaccination.	0	1(0.5)	6(4.0)	2(7.7)
Other logistic problems.	0	1(0.5)	3(2.0)	0
Important factors to increase confidence in the COVID-19 vaccine.	**Chose one option (n = 395)**	**Chose two option (n = 389)**	**Chose three option (n = 357)**	
The fast production of the vaccine did not compromise its safety.	37(9.4)			
Agencies approving the vaccines are following strict rules.	132(33.4)	13(3.3)		
Risk of getting sick with COVID-19 is bigger than the risk of side effects from the vaccine.	149(37.7)	59(15.2)	5(1.4)	
The vaccine does not cause any immediate or long-term injury.	60(15.2)	153(39.3)	46(12.9)	
It is impossible to get COVID-19 or any other disease from the vaccine itself or its components.	4(1.0)	89(22.9)	86(24.1)	
The vaccine works in protecting against COVID-19.	11(2.8)	52(13.4)	117(32.8)	
The vaccine works in stopping the transmission of COVID-19 from one person to another.	2(0.5)	21(5.4)	62(17.3)	
Health agencies and WHO recommend the vaccine and agree it is safe.	0	2(0.5)	35(9.8)	
Do not need any other information.	0	0	6(1.7)	
Important factors to increase the likelihood of administering the COVID-19 vaccine.	**Chose one option (n = 395)**	**Chose two options (n = 382)**	**Chose three options (n = 358)**	
Able to live with no restrictions once vaccinated.	282(71.4)			
Those concerned about the vaccine can share their opinions with the public.	101(25.5)	178(46.6)		
Pharmaceutical companies will not make large profits from the vaccine.	7(1.8)	117(30.6)	72(20.1)	
Everybody will have equal access to the vaccine regardless of income or race.	4(1.0)	84(22.0)	135(37.7)	
Will be free to choose the need for a vaccine with no consequences.	1(0.3)	3(0.8)	151(42.2)	

accept a COVID-19 vaccine (Folcarelli et al., 2022). An online web survey conducted earlier also reported that age and ethnicity in demographic characteristics significantly correlate with vaccine acceptance (Lau et al., 2021). In the current study, different races in Malaysia had almost similar vaccine acceptance. There were also other studies showing Chinese ethnicity working in non-medical related sectors have higher acceptance of booster vaccines, particularly for vector vaccines. However, the study did not share the reason behind the choice (Chang et al., 2022). In the United States, black individuals reported having the lowest acceptance of the COVID-19 vaccine compared to other races, such as Hispanic, Middle-eastern and North African, and Asian. On top of that, black participants are also reported to have the highest medical mistrust score compared to other races. The overall mean rejection rate was reported to be highest among black participants (B [SE], 0.51 [0.08]; $p < 0.001$) and less rejection among Asians (B [SE], −0.63 [0.14]; $p < 0.001$) and White (B [SE], −0.20 [0.07]; $p = 0.005$) (Thompson et al., 2021). Therefore, influence of age and racial factor on vaccine acceptance could be prevalent in certain region of the world.

In the current survey, 90.4% were found to use smartphones; meanwhile, smartphone usage in Malaysia was reported to be 98.7%. Among the smartphone users in the survey, 92.7% accept booster dose administration. Mobile phone usage helps to create awareness of the need for booster doses or serves as a tool to gather information (Department of Statistics Malaysia, 2021e; Williams et al., 2017). Those residing in urban have a higher rate of vaccine acceptance, 72.0% compared to sub-urban, 57.3% or rural areas, 50.0%. Similarly, a previous study by Wong et al. on acceptance of COVID-19 booster doses reported high acceptance among those with high monthly household income and residents in more populated urban as they are more impacted by COVID-19 (Wong et al., 2022). However, another COVID-19 vaccine acceptance study in a global study involving 20 countries by Marzo et al. reported that residents in rural areas have a higher acceptance rate compared to residents in urban and shared that urban residents' acceptance could be lower due to higher dissemination of information pertaining to side effects of COVID-19 vaccination among residents in an urban area. The study also reported that respondents with higher education, especially tertiary education, are more likely to accept vaccination compared to lower levels of education, such as post-secondary, secondary or lesser (Marzo et al., 2022a, 2022b). The findings in terms of education match with the current study where education was significantly associated with acceptance among respondents with postgraduate qualification reported to be the highest, followed by those with high school qualification, diploma or equivalent, bachelor and advance diploma or equivalent (71.72%). However, in other countries such as China, respondents with higher education levels reported low acceptance of COVID-19 booster doses (Lai et al., 2021). Lower booster dose acceptance among those with higher education levels was also reported in countries such as the UK, Spain and Canada (Lazarus et al., 2020).

The current study also finds that, more then half of the participants are still willing to accept a COVID-19 booster vaccine despite existing comorbidities ($p = 0.019$). This could be due to government policies which strongly advises people with comorbidities to be vaccinated due to their higher risk of hospitalisation and mortality. Similarly in a study conducted in Poland, majority of immunosuppressed invidivuals (88%) are willing to accept a COVID-19 booster vaccination (Rzymski et al., 2021). As of October 2022, the majority of the population in Malaysia have received Pfizer's COVID-19 vaccine (61.2%), followed by Sinovac (29.8%), AstraZeneca (7.9%) and Cansino (0.3%) (Malaysia, 2022). Similarly, most of the respondents in the survey received Pfizer followed by Sinovac. In Malaysia, 86.1% reported receiving the first dose, and 84.3% received the second dose of the COVID-19 vaccine. Uptake of the first booster dose dropped drastically to 50.0% and the most recent second booster rollout only had 2.5% recipients as of April 2023 (Ministry of Health Malaysia, 2023). Therefore, compared with the overall population in Malaysia, respondents in this survey had a higher acceptance rate (69.4%) for the first or second booster dose. Similar findings on high acceptance of COVID-19 booster doses among Malaysians have also been reported by Chang et al., where 87.6% were willing to accept booster doses out of 6,294 respondents (Chang et al., 2022).

As of March 2023, only 50.0% of the population in Malaysia received the first booster dose and 2.5% recipients of the second booster (Ministry of Health Malaysia, 2023). There could be more who are willing to receive the booster dose since more studies show a high acceptance rate. In the current survey, 37.0% of respondents prefer the heterologous vaccination method as the preferred booster dose administration choice. 26.3% preferred a similar vaccine to one administered earlier during the first and second dose administration. Meanwhile, 36.5% of respondents have no preference, and the most cited deciding factor for acceptance of the COVID-19 booster vaccine is based on more clinical studies on the need for the COVID-19 booster dose. The study by Chang et al. reported that 23.3% of the respondents were not willing to have heterologous vaccination. The same study also reported that the vaccine's efficacy is the most common reason (63.6%) for determining their acceptance. The preference for booster dose by brand in that study was reported to be highest with Pfizer (65.7%), followed by Astra-Zeneca (21.9%), Sinovac (20.9%), Sinopharm (2.5%), CanSino (2.3%) and 14.9% had no preference (Chang et al., 2022). One possible reason for having more respondents opting for heterologous vaccination methods could be high literacy or education level. Educated respondents could have more substantial knowledge of the higher effectiveness of heterologous vaccination towards different variants of COVID-19..

The current study also shows a high acceptance rate, and participants are willing to recommend booster dose administration (81.5%) for their immediate family members, such as children and elderly parents was also seen to be high among respondents. The possible reason behind strong recommendations to family members could be the high number of cases when the survey was conducted. Similarly, a previous study has reported a higher number of cases and belief that vaccine reduces the risk of infection and opinions from friends and family members that booster is helpful to have a higher impact in increasing the acceptance of booster dose (Lee et al., 2023). Similarly, in this study, 53.9% of participants believe the risk of getting sick with COVID-19 is bigger than the vaccine's side effects. Another reason that can be correlated with participants' high acceptance of booster doses in the current survey is that the larger group (71.4%) of respondents wanted to live without restrictions post-vaccination. In the current study, 56.5% also stated that they did not refuse a vaccine given by a healthcare provider; this could also be due to HCWs' advice on the need for COVID-19 vaccination. Healthcare workers' advice to the general population is essential for a higher acceptance rate of COVID-19 booster doses. In a study in Southern Italy, physicians cascaded information pertaining to vaccination to parents, which increased the willingness for COVID-19 vaccination acceptance for their children (Miraglia Del Giudice, Della Polla, et al., 2023a, 2023b). Similarly, in another study in Southern Italy, information on vaccination given by physicians to patients who have chronic medical conditions increased the likelihood of the patients in administration of second COVID-19 booster dose (Miraglia Del Giudice, Della Polla, et al., 2023a, 2023b). Two consecutive study in China which evaluated more than 2058 respondents also found that healthcare providers' recommendation had impact on immediate vaccination during the severe pandemic phase (Wang et al., 2021).

Table 6
Simple logistic regression output on consideration to obtain a subsequent COVID-19 booster dose (first or second booster dose) with covariates.

Variable		Simple Logistic Regression		
		OR	p-value [a]	95% CI
Gender	Ref: Male	–	–	–
p = 0.738	Female	0.607	0.523	0.131–2.803
Marital status	Ref: Single	–	–	–
p = 0.283	Married	0.453	0.097	0.178–1.155
	Divorced	0.534	0.146	0.229–1.244
	Widow	0.345	0.073	0.108–1.103
Age range	Ref: 20–29	–	–	–
p = 0.09	30–39	0.292	0.008	0.118–0.725
	40–49	0.698	0.330	0.338–1.439
	50–59	0.704	0.379	0.322–1.539
	60–69	0.439	0.046	0.195–0.987
	70 and over	0.508	0.105	0.224–1.152
Race	Ref: Malay	–	–	–
p = 0.906	Chinese	0.638	0.626	0.105–3.882
	Indian	0.708	0.719	0.108–4.641
	Others	0.786	0.807	0.114–5.425
Education level	Ref: Below high school, e.g. SPM/SPM(V) qualification	–	–	–
P = 0.04	High school eg SPM, SPM(V) & equivalent	1404719192.691	0.999	–
	Certificate/TVET (Technical and vocational education)	550713774.407	0.999	–
	Diploma/ STPM or equivalent (College)	1938512485.913	0.999	–
	Bachelor/advanced diploma or equivalent	634632063.841	0.999	–
	Postgraduate (Master/PhD)	636851057.071	0.999	–
Occupation	Ref: Unemployed/Retired	–	–	–
P = 0.688	Executive/Administrator CEO, CFO, COO & etc	935354060.013	1.000	–
	Skilled workers	727752954.146	1.000	–
	Semi-skilled workers	766730908.978	1.000	–
	Labourer	346202476.758	1.000	–
	Own business	570215844.072	1.000	–
Sector	Ref: Government	–	–	–
p = 0.581	Private/Own business	0.928	0.823	0.482–1.787
	Not applicable	0.764	0.372	0.423–1.380
Monthly household income	Ref: Below RM2,500	–	–	–
p = 0.251	RM2,501 – RM 4,849	2.218	0.118	0.818–6.020
	RM4,850 – RM 10,959	1.235	0.653	0.492–3.096
	RM10,960 and above	1.364	0.508	0.544–3.416
Living area	Ref: Urban	–	–	–
p = 0.050	Sub-urban	0.389	0.506	0.024–6.283
	Rural	0.744	0.836	0.045–12.390
Smartphone usage	Ref: Yes	–	–	–
P = 0.746	No	0.451	0.021	0.229–0.886
Illness/disease	Ref: Healthy	–	–	–
P = 0.068	Obesity	0.388	0.013	0.184–0.818
	Cancer	0.265	0.009	0.098–0.717
	Chronic kidney disease	0.800	0.767	0.183–3.503
	Cardiovascular disease	0.000	0.999	–
	Diabetes mellitus	0.286	0.030	0.092–0.884
	Pulmonary disease	0.857	0.727	0.361–2.037
	Autoimmune disease	0.000	0.999	–
	Two comorbidities	0.000	0.999	–
	Three or more comorbidities	0.333	0.025	0.128–0.869
Previous infection with COVID-19	Ref: I had suspected symptoms but did not verify with the doctor/RT-PCR examination	–	–	–
P = 0.702	No	2.250	0.235	0.590–8.579
	Yes (no symptoms)	1.232	0.684	0.451–3.365
	Yes (mild symptoms, fever, cough and fatigue)	1.182	0.730	0.457–3.057
	Yes (moderate symptoms – difficulty breathing or mild pneumonia)	1.111	0.829	0.426–2.899
	Yes (severe symptoms – severe pneumonia, organ failure)	0.643	0.472	0.193–2.142
	Yes (Hospitalised or Low-Risk Quarantine and Treatment Centre)	1.286	0.796	0.191–8.672
COVID-19 vaccine received	Ref: Administered the first dose	–	–	–
p = 0.067	Administered the second dose	–	0.999	–
	Administered the third dose	1.667	0.734	0.087–31.869
	Did not receive COVID-19 vaccine	0.418	0.539	0.026–6.747
Type of 1st COVID vaccine	Ref: Pfizer BioNTech	–	–	–
p = 0.645	Astra-Zeneca	664543391.271	–	–
	Sinovac	969210976.808	–	–
	Cansino	689216694.619	–	–
Type of 2nd COVID vaccine	Ref: Pfizer BioNTech	–	–	–
p = 0.467	Moderna	0.892	0.656	0.541–1.473
	Astra-Zeneca	3671533733.753	–	–
	Sinovac	1.452	0.271	0.747–2.822
Side effects from previous vaccination	Ref: Experienced side effects from the first vaccine dose administration	–	–	–
p = 0.031	Experienced side effects from the second vaccine dose administration	2.719	0.010	1.268–5.831
	Experienced side effects from first and second vaccine dose administration	2.333	0.212	0.617–8.820
	Did not experience any side effect	2.733	0.004	1.389–5.377

[a] The univariate test conducted was two sided.

Among the factors affecting booster dose acceptance, the need for more clinical studies on COVID-19 booster doses was cited by 58.2% of respondents, followed by the need for more information from the government (52.1%). This is consistent with a previous study on booster dose acceptance conducted in Malaysia, where 41.8% required suggestions from doctors or policymakers from the Ministry of Health to accept booster doses better. The same study also reported that those less willing to administer booster doses were worried about booster vaccination's side effects (Chang et al., 2022). The concern over the vaccine's side effects also matched the outcome in the current study, where 27.3% of participants quoted it as the reason to refuse booster vaccination. On top of that, in the current study, 65.6% of participants feel that the vaccine does not cause any immediate or long-term injury, making them more confident to accept a COVID-19 booster dose. To our knowledge, this is one of the first studies that assessed the willingness of booster dose acceptance with a physical questionnaire compared to the previous web-based studies. The study addressed feedback from more elderly participants who might not be technology savvy. Besides that, the study also had the representation of participants throughout Malaysia. Therefore, it could be valuable input for the government to devise policies and strategies to increase vaccination acceptance among the public.

5. Conclusion

The acceptance of COVID-19 booster doses appears to be high in Malaysia. There appears to be a correlation between educational level, geographical location and the use of technology among the public towards accepting COVID-19 booster doses. Emphasising the need for more clinical studies and updates on the need for booster doses will increase the acceptance of COVID-19 booster doses among the public.

6. Study limitations and future perspectives

The current study did not assess the preference of booster dose acceptance by brand for the heterologous mix. The study also did not get input from those with disabilities, such as the visually impaired group. Besides that, the study's population from East Malaysia was relatively smaller than other states in Malaysia. On the other hand, those not formally educated cannot complete the study due to their lack of understanding of the required information. The questionnaire was only available in English and Malay language. Adding questionnaires in more languages, such as Mandarin and Tamil, could have potentially recruited non-English or Malay-speaking participants, especially among the elderly population in Malaysia. The study also may have been exposed to a certain level of self-selection bias where the survey participation is voluntary and could have attracted individuals who are more concerned and updated about COVID-19.

On the other hand, participants may have input responses due to social desirability bias in acceptance of booster dose vaccination. Respondents' responses also could have been influenced by recall bias on aspects such as side effects which may have been forgotten by participants and may be left uncaptured. These biases are not quantified in the study. This cross-sectional study also may only represent views from a specific time frame; therefore, responses obtained may only reflect participants' opinions, and opinions may differ from time to time according to different factors influencing the acceptance of the COVID-19 vaccine.

Author contributions

Contributor Suresh Rajakumar (SR) drafted the manuscript. SR and Sutha Rajakumar(SRK) were involved in the statistical analysis. MAA, NS, & HZH read, provided feedback and approved the final manuscript.

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Availability of data and materials

The author confirms that all data generated or analysed during this study are included in this published article.

Ethical approval

Informed consent was obtained from all individual participants included in the study. Ethical approval (UM.TNC 2/UMREC) was obtained from University of Malaya Research Ethics Committee (UMREC).

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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