ORIGINAL ARTICLE

The Price of Protection: How Much Urban Muslim Communities in Selangor Are Accepting and Willing to Pay for Covid-19 Vaccines?

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ABSTRACT

Introduction: The novel coronavirus disease 2019 (COVID-19) has been a major public health crisis worldwide since early 2020. In Malaysia, a religious gathering in Seri Petaling resulted in the largest cluster with 3,375 cases and 34 deaths, leading the government to impose movement restriction policies. However, after these policies were eased in mid-2021, cases involving religious institutions and communities increased again. The COVID-19 vaccination and other preventive practices were believed to be the way forward to ending the pandemic. This research aimed to measure the acceptability and willingness to pay (WTP) for the COVID-19 vaccine and the associated factors among the Muslim community if it were available at private health institutions. **Method:** In 2021, an online survey was conducted using the contingent valuation method (CVM) among Muslim residents of Bandar Baru Bangi, a suburban town in Selangor state, Malaysia, who attended prayers at mosques and prayer rooms (surau) in that area. **Results:** The analysis indicated that 97.35% (n=478) of the 491 respondents accepted COVID-19 vaccination, and 81.71% (n=388) were willing to pay for the vaccine, with a mean value of MYR141.05 (±98.70) (US$34.07, ±23.85) per dose. The predictors of WTP, as analysed by multiple logistic regression, were age group under 51 years and monthly household income of more than MYR4,850 (US$1,147). **Conclusion:** Most respondents accepted the COVID-19 vaccine, and more than 80% were willing to pay. This research highlighted the acceptability and price range residents would pay if the vaccine were available.
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INTRODUCTION

A cluster of pneumonia cases of unknown origin was detected in late December 2019 until January 2020 in Wuhan City, China (1). SARS-CoV-2, a new coronavirus named by the International Committee on Taxonomy of Viruses (ICTV), was described as the pathogen causing the illness, ecologically originating from bats that had been closely linked to a seafood market in the province (2). On January 11, 2020, the World Health Organization (WHO) confirmed that the causal agent was a novel coronavirus causing the coronavirus disease 2019 (COVID-19). The disease spread expeditiously throughout the globe and was later discovered to spread through respiratory droplets and contact routes (3). As the disease advanced to nearly 20 countries with almost 10,000 confirmed cases, the WHO declared the outbreak a Public Health Emergency of International Concern (PHEIC) on January 30, 2020, following the recommendations of the IHR Emergency Committee, and later as a global pandemic on March 11, 2020 (4).

Following these events, the Malaysian Ministry of Health (MOH) continuously advised the public to instil the 3W behaviour (wash both hands with soap and water, wear a face mask if having symptoms or in public, and warn about the threats of COVID-19), and avoid the 3C (crowded places, confined space, and close conversation). The Director-General of Health of Malaysia continuously promoted the concept to break the chain of infection (5). As of September 1,

2021, Malaysia had recorded 1.76 million COVID-19 cases with 17,000 deaths. Early clusters in 2020 were mainly attributed to the religious Sri Petaling gathering, corporate sectors, and immigration detention centre clusters. Despite these efforts, vaccination emerged as a cost-effective and proven method to prevent and ultimately eradicate this infectious disease, as the World Health Organization (WHO) envisioned through the Global Vaccine Action Plan 2011-2020.

Achieving herd immunity requires a sufficiently large amount of people in the community to gain natural or vaccine-induced immunity, with a significant duration of immunity level. Such defence is crucial against an event of a disease outbreak (6). Gaining the community's trust to accept vaccines' role in eradicating disease and safeguarding them to access the benefits requires cooperation from all entities. In research analysing the determinants of the COVID-19 vaccine acceptance in the U.S., only 67% out of 672 respondents believed the vaccine, where the difference could be seen in their demographic and geographical variations (7). In Jordan, the acceptance of the vaccine was 37.4%. Factors for the low acceptance rate in the country include employment, belief in conspiracy theories, and vaccine mistrust (8). Understanding vaccine acceptability provides valuable insights for guiding COVID-19 vaccination initiatives.

Assessing vaccine acceptance enhances comprehensive coverage by identifying barriers to vaccination and understanding the attitudes and beliefs of different populations. This information allows public health officials to develop targeted strategies, educational campaigns, and policies that address concerns, increase trust, and encourage higher vaccination rates, especially among at-risk groups. Malaysia has a population size of 32.67 million, with Islam being the largest (61.3%) religion followed (9). Various factors such as vaccine efficacy and effectiveness, its origin, perception towards vaccination, religious belief, and others may affect vaccine acceptance among the population (8, 10, 11). For example, in an online survey among Malaysian residents aged between 18 and 70 years, half of the respondents were concerned with the vaccine's halal status, making it one of the factors influencing its use among the Muslim population (11). The halal status of the vaccine has always been an essential issue among Muslims, besides concerns about its safety and side effects (12). Considering that vaccination against COVID-19 is a significant method to end the pandemic, manufacturing a vaccine that is compliant with halal standards is particularly important in Malaysia (11).

Meanwhile, the WTP for the vaccine would indicate how much the society would spend on their health through the cost-benefit analysis (CBA) method. The WTP could assess economic efficiency through money metrics from the analysed systematic prediction of social costs and benefits (13). Over the past ten years, multiple studies have evaluated the public's necessity to allocate a certain amount of capital for a cure. Research on the population's willingness to pay for hypothetical or already available vaccines shows that the majority were inclined to spend on vaccines. A study in Indonesia by (14) adopted the contingent valuation method to estimate the WTP for a hypothetical vaccine. 78.3% of the 1,359 respondents will pay for the vaccine, with mean and median WTP of US$57.20 (95%CI: US$54.56, US$59.85) and US$30.94 (95%CI: US$30.94, US$30.94), respectively. Most respondents who are willing to pay would agree to pay US$15.49 (29.3%), and it decreases as the price doubles further, with only 16.1% opting to pay US$123.76 for the vaccine. Monthly income was the strongest determinant for the study's WTP for the COVID-19 vaccine (14). In a similar study in Malaysia, most participants were willing to pay an amount of MYR 100 [US$23] (28.9%) and MYR 50 [US$11.5] (27.2%) for the vaccine, with a mean of MYR 134.00 (US$30.66) (11).

In the Malaysian context, until November 2020, the Seri Petaling Cluster, a multinational religious congregation held in a mosque, was the largest in the country with 3,375 cases, which was almost 10% of the national total cases at that time and 34 deaths. The cluster spanned from March 11 until July 8, 2020 (15). Such congregations would allow the virus to spread as physical distancing would be difficult to comprehend (16). The multinational mass gathering had acted as a stimulant for further spread within the country and internationally to Singapore, Indonesia, Thailand, and other countries. Unfortunately, a two-week delay between the Seri Petaling event and the nationwide Movement Control Order (MCO) announcement on March 18, 2020, allowed the virus to spread (17). The participants of that congregation had unknowingly transmitted the virus as they may not have experienced any symptoms during the incubation period. Subclusters of Seri Petaling were also seen in the neighbouring district of Hulu Langat, with nearly 300 cases connected to a religious school, a wedding ceremony, and several neighbourhoods, including the nearbysuburban area called Bandar Baru Bangi.

The enforcement of various standard operating procedures (SOPs) and personal preventive measures have undoubtedly created a new norm for the nation. At the same time, numerous studies on COVID-19 have been conducted, focusing on its pathology, health effects, treatments, and vaccines. Scientists and governments globally eagerly anticipated the development of several vaccines against COVID-19 as a crucial step in curbing the pandemic. While initial studies explored the community's willingness to accept and pay for the new vaccine, subsequent research has delved deeper into these factors.

Given that one of the largest COVID-19 clusters involved

a specific religious group in Malaysia, a group where some portion might be concerned about vaccine origins, such as those derived from animal products, assessing their acceptability and willingness to pay (WTP) for the COVID-19 vaccine was particularly important. While this group may be more susceptible to vaccine hesitancy and misinformation, the findings from this study would suggest their acceptance level and WTP for the vaccine (18).

Although Malaysia employs a holistic healthcare system to achieve herd immunity through free vaccination programs, exploring WTP for vaccines serves multiple purposes. First, it provides insights into the economic burden-sharing potential between the government and citizens, which could help rationing budget allocations for those in greater need. Second, understanding WTP can inform policymakers about the feasibility of alternative financing mechanisms, ensuring sustainable vaccine distribution in the long term, especially in contexts where resource allocation must be carefully prioritized. Therefore, this study aimed to ascertain vaccine acceptance and determine the monetary value a religious suburban community would be willing to invest in should the government's policy require citizens to pay for the COVID-19 vaccine.

MATERIALS AND METHODS

An analytical cross-sectional study was conducted in a suburban area called Bandar Baru Bangi, in Hulu Langat district, Selangor, among residents attending prayer at the local mosques and praying rooms (surau). There were two mosques and thirty-four surau in Bandar Baru Bangi under the jurisdiction of the Hulu Langat District Islamic Religious Office (Pejabat Agama Islam Daerah Hulu Langat, PAID). The data collection was conducted using a validated contingent valuation method (CVM) between May and July 2021, before the start of the COVID-19 vaccination programme by the Ministry of Health Malaysia. An online data collection was performed during the movement control order when COVID-19 was surging to assess acceptability and WTP for the COVID-19 vaccine against their socio-demographic, socio-economic, knowledge, and perception. Inclusion criteria were committee members and congregants attending the chosen prayer institution, Malaysians, and adults aged 18 years and above.

The cluster sampling method was used to select the mosques and surau in Bandar Baru Bangi, followed by the universal sampling from congregants attending the institutions. Universal sampling refers to the selection of a sample where not all the people in the population have the same profitability of being included in the sample. For each one of them, the probability of being selected is unknown. The sample size for hypothesis testing was based on the two-proportion formula by (19), in addition to sample inflation due to the design effect factor of two of a cluster sampling. Considering a response rate of 43% for an online survey, the minimum sample size required for the study was 655 subjects (20, 21). An estimated twenty to thirty respondents from each cluster would participate in the study. The representative from the chosen institutions distributes the online questionnaire link to the committee members and congregants of the mosques and surau through social media platforms such as WhatsApp or Telegram groups of respective institutions.

Information on the respondents' socio-demographic characteristics was collected in terms of their demographics and socio-economic factors, such as occupation categories and household income. Knowledge level was assessed using 24 three-choice answer questions (thirteen items were asked on COVID-19 symptoms, transmission, and preventive practices while eleven questions were on COVID-19 vaccine) by a study by (22). Six questions assessed the perception regarding the likelihood of getting COVID-19 infection COVID-19 and the government's handling of COVID-19 was evaluated using Likert-scale questions adapted from previous similar studies (23-25). A question with a dichotomous answer determined the acceptability towards the vaccine. Respondents who agreed to vaccination were asked the following question about their willingness to pay for the vaccine, and the answer was evaluated using the bidding technique as outlined by (26). On January 5, 2021, the minister of MOSTI announced the cost of a COVID-19 vaccine dose was MYR77.35. If the respondent answered 'Yes' to the initial question, "Are you willing to pay RM77.35 for a dose of COVID-19 vaccine?" the respondent was asked to state the willingness to pay if the bid was doubled to MYR154.70 and MYR309.40 (the highest value). If the respondent did not agree to pay MYR77.35 for one dose of the COVID-19 vaccine, the value was halved to MYR38.70 and further to MYR0.00 (indicating unwillingness to pay) (14).

The monthly household income groups for respondents, spouses, or any other household members were evaluated according to the Household Income & Basic Amenities Survey Report 2019 by the Department of Statistics (DOSM) in 2020 (27) . The fixed income band classifications were as follows: the B40 group comprising of household income band earning below RM4,849 (B1 to B4 subgroups), the M40 group earning between RM4,850 to RM10,959 monthly (M1 to M4 subgroups), and T20 group earning the most more than RM10,960 monthly, comprising the T1 and T2 subgroups. These income classifications were developed by DOSM to reflect the household disposable income capability of Malaysians.

The questionnaire's content validity was discussed with the experts in the field, including the supervisory committee and Public Health Specialists from the

Ministry of Health (Hulu Langat District Health Office and the National Public Health Laboratory) to ensure clarity, content relevance, and comprehension for each item in the questionnaire. In evaluating the phrasing and understanding of the questions, the questionnaire's face-validity testing was conducted on the congregants of a surau in Dengkil, where the community shared characteristics similar to those of the studied population. An intra-class correlation (ICC) value of 0.84 was obtained through Cronbach's alpha analysis, which suggested a good degree of reliability for the questionnaires.

Descriptive statistical analysis was conducted to summarise the data using frequency, percentage distribution, mean and standard deviation, or median and interquartile range. The association between the dependent and independent variables was initially measured using simple logistic regression analysis. The level of significance was set at 0.250. A higher significance level was selected, so important variables with significant associations with WTP were not missed during variable selection in multivariate analysis (28). The predictors of acceptability and willingness to pay for the COVID-19 vaccine were based on statistically significant variables in dichotomous analysis using multiple logistic regression statistics to determine the predictors of the study. The level of significance (α) was set at 0.05.

Ethical approval to conduct the research was acquired from the Ethics Committee for Research Involving Human Subjects (JKEUPM), Universiti Putra Malaysia, with the approval letter UPM/TNCPI/RMC/1.4.18.2 (JKEUPM) on May 15, 2021. Permission to conduct the study was obtained from PAID Sepang and PAID Hulu Langat at respective institutions in the district. Consent was obtained from each respondent upon distributing the questionnaire form, and confidentiality of the information given to the researcher was guaranteed.

RESULTS

A total of 497 respondents accessed the questionnaire link provided. Six respondents did not complete the questionnaire. Therefore, 491 responses were analysed in this study. The majority of the respondents were male (n=334, 68.00%), aged 51 years and above (n=258, 52.55%), and had formal education up to the first-degree level (n=223, 45.41%). Most respondents have between five and seven household members (n=249, 50.71%) and two or fewer dependent children (n=295, 60.08%). as shown in Table I.

Table I: General characteristics of respondents (N=491)

Characteristics	Median (IQR)	n	%
Age (years)	51.00 (17.00)		
18-30		33	6.72
31-40		77	15.6
41-50		123	25.0
51 and above		258	52.5
Sex			
Male		334	68.0
Female		157	32.0
Highest Education Level			
No formal education		1	0.20
Secondary school		23	4.68
Matriculation/ Diploma		75	15.2
First Degree		223	45.4
Masters or Ph.D		164	33.4
Others		5	1.02
Household size (persons)	5.00 (2.00)		
less than 5		195	39.72
5 to 7		249	50.71
8 or more		47	9.57
Number of dependent children	2.00 (2.00)		
2 or less		295	60.08
3 or more		196	39.92
Occupational category			
Professional		241	49.0
Entrepreneurs		33	6.72
Support Staff		24	4.88
Student		13	2.44
Housewife		22	4.48
Retired		119	24.2
Self-employed		13	2.64
Unemployed		26	5.29
Household income (MYR)			
Less than 3,170 (B1 and B2)		49	9.98
3,170 to 4,849 (B3 and B4)		60	12.21
4,850 to 7,099 (M1 and M2)		95	19.35
7,100 to 10,959 (M3 and M4)		89	18.13
More than 10,960 (T1 and T2)		198	40.33

General characteristics of respondents (N=491). This table displays the demographics of the respondents that were included in the study. The table displays their gender, age, education level, and household member characteristics.

The respondents' median knowledge score was 19.00 (IQR=4.00) out of 24.00. Knowledge score was further categorised into sufficient knowledge with a score of 19.00, scoring 80% correct answers and above and insufficient knowledge with a knowledge score below 19.00 (29). A total of 303 (61.71%) respondents had sufficient knowledge regarding COVID-19. The maximum knowledge score obtained by respondents was 24.00, and the minimum score was 8.00. Most of the

respondents answered correctly for the knowledge item "The main clinical symptoms of COVID-19 are fever, fatigue, dry cough, and body aches" (94.91%), "It is not necessary for children to take measures to prevent the infection by the COVID-19 virus" (76.99%), "COVID-19 vaccines will be given via injection" (74.74%), and Infection by the COVID-19 virus can be prevented by staying away from crowded places" (74.54%).

On the other hand, the most wrongly answered and answered do not know, were the statements "COVID-19 vaccine can also protect us from influenza" (65.78%), "Symptoms such as blocked nose, runny nose, and sneezing are less common in persons infected with the COVID-19 virus", (64.36%), "COVID-19 vaccines manufactured by Sinovac Biotech and Sinopharm uses inactivated coronavirus as the antigen" (49.70%), and "COVID-19 vaccine protects the receiver from getting COVID-19 infection" (46.84%).

The distribution of respondent's perceptions of COVID-19 is displayed in Table II. The median total score achieved by the respondents was 23.00 (IQR=6.00) out of 30.00. Perception score is further categorised into good perception, with scores of 23.00 and above, and poor perception towards COVID-19, with scores of 22.00 and below. Overall, 290 (59.06%) of respondents had good perception towards COVID-19. The maximum perception score obtained by respondents was 30.00, and the minimum score was 6.00.

Table II: Distribution of respondent's perception towards COVID-19 (N=491).

No	Perception	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
		n (%)	n (%)	n (%)	n (%)	n (%)
1.	I can be infected with the COVID-19 virus.	19 (3.86)	10 (2.04)	72 (14.66)	223 (45.42)	167 (34.01)
2.	I am at risk of getting a severe COVID-19 infection.	23 (4.68)	52 (10.59)	163 (33.20	160 (32.59)	93 (18.94)
How much do you agree with the Malaysian government's measures on the following aspects:						
3.	Information on the COVID-19 outbreak through official channels.	24 (4.89)	20 (4.07)	72 (14.66)	173 (35.23)	202 (41.14)
4.	Recommendations to address the COVID-19 crisis include wearing face masks, physical distancing, and the Movement Control Order (MCO).	24 (4.89)	7 (1.423)	60 (12.22)	157 (31.98)	243 (49.49)
5.	Efforts to help its citizens follow the MCO are still being enforced.	38 (7.73)	30 (6.11)	81 (16.50)	169 (34.43)	173 (35.23)
6.	Overall, the government has handled the COVID-19 pandemic well.	73 (14.87)	91 (18.53)	125 (25.46)	130 (26.48)	72 (14.66)

Distribution of respondent's perception towards COVID-19 (N=491). This table shows the perception of respondents towards COVID-19, where those scoring 23 and above have good perception, while those scoring 22 and below show poor perception towards COVID-19 based on the questionnaire given.

The acceptability of the COVID-19 vaccine was high (n=478, 97.35%) among the total respondents. The analysis demonstrated that 388 (81.17%) respondents were willing to pay at least MYR38.70 (US$9.35) for the COVID-19 vaccine. The mean (±standard deviation) of WTP was MYR141.05 (±98.70) (US$34.07, ±23.85). Table III outlines the distribution of the willingness to pay for the price of the COVID-19 vaccine among study respondents using the bidding technique as outlined by Cooper (26). Of 478 respondents who accepted the vaccine, 319 (29.08%) were willing to pay MYR77.35 for the COVID-19 vaccine. Of the respondents who responded "No" to the initial bid, 69 (14.44%) would rather pay MYR38.70, while the remaining 90 (18.8%) respondents were not willing to pay. On the contrary, 93 (19.45 %) out of the respondents who agreed to the initial bid will pay the doubled price of MYR154.70 for a dose of COVID-19 vaccine. Finally, 87 (18.20%) respondents were willing to pay if the vaccine's price is further doubled at MYR309.40 per dose.

Table III: Distribution of WTP status among those who accepted the COVID-19 vaccine (N=478).

Variable	Frequency, n	Percentage(%)	Mean (SD)
Maximum WTP			MYR141.04 (98.70)
MYR0.00	90	18.83	
MYR38.70	69	14.44	
MYR77.35	139	29.08	
MYR154.70	93	19.45	
MYR309.40	87	18.20	
TOTAL	478	100.00	

Distribution of WTP status among those who accepted the COVID-19 vaccine (N=478). The WTP of respondents agreeing to pay for a dose of the vaccine was assessed by using the bidding method initially set at RM77.35. The price was either doubled or halved based on their response.

For univariate analysis, simple logistic regression analysis between factors and WTP is displayed in Table IV. All significant variables with p-values less than 0.250, namely age group, gender, household size, occupational category, household income, and chronic diseases, were included in multiple logistic analyses to determine the final predictor model for this study. Multiple logistic regression was performed to find the predictors of WTP for the COVID-19 vaccine, as shown in Table V. The Forward Wald method was applied. The Omnibus test of model coefficients was statistically significant ($\chi 2$ (5) =23.352, p=<0.001). The model was able to explain 7.7% (Nagelkerke R square) of the variability of WTP, and the Hosmer and Lemeshow test ($\chi 2$ (7) =1.416, p=0.985) shows that the model has a good fit.

Table IV: Simple logistic regression between independent variables and WTP

Variable	Coefficient, β	SE	Odds Ratio	95% CI		p-value
				Lower	Upper	
Age group						
18 – 30	0.799	0.554	2.224	0.750	6.592	**0.149***
31 – 40	0.710	0.370	2.033	0.984	4.203	**0.055***
41 – 50	0.790	6.371	2.203	1.193	4.067	**0.012***
51 and above	Ref					
Gender						
Male	Ref					
Female	0.303	0.262	1.354	0.811	2.261	**0.247***
Household size						
less than 5	Ref					
5 to 7	0.506	0.251	0.603	0.368	0.987	**0.044***
8 or more	-0.272	0.381	0.762	0.361	0.361	0.475
Number of dependent children						
2 or less	Ref					
3 or more	0.251	0.243	1.286	0.798	2.070	0.302
Occupation category						
Professional and managerial	0.861	0.256	2.366	1.434	3.906	**0.001***
General worker	0.561	0.388	1.753	0.820	3.750	**0.148***
Student	1.499	1.055	4.476	0.566	35.378	**0.155***
Housewife/ Retired/ Self-employed/ Unemployed	Ref					
Household income (MYR)						
Less than 4849 (B40)	Ref					
4,850 to 10,959 (M40)	0.583	0.288	1.791	1.019	3.149	**0.043***
More than 10,960 (T20)	0.994	0.300	2.703	1.501	4.865	**0.001***
Chronic disease						
Respondent						
Yes	Ref					
No	0.349	0.238	1.417	0.889	2.258	**0.143***
Family members						
Yes	Ref					
No	0.074	0.249	1.077	0.661	1.754	0.765
Supplementary vaccination uptake						
Never	Ref					
Some years	0.106	0.280	1.111	0.643	1.922	0.706
Yearly	-0.213	0.294	0.808	0.455	1.437	0.468
History of COVID-19 infection						
Respondent						
Yes	Ref					
No	0.377	0.590	1.457	0.459	4.628	0.523

CONTINUE

Table IV: Simple logistic regression between independent variables and WTP (CONT.)

Variable	Coefficient, β	SE	Odds Ratio	95% CI		p-value
				Lower	Upper	
Family members						
Yes	Ref					
No	-0.164	0.406	0.849	0.383	1.882	0.687
Knowledge						
Sufficient	Ref					
Insufficient	0.006	0.241	1.006	0.627	1.615	0.979
Perception						
Good	Ref					
Poor	0.206	0.236	1.229	0,773	1.952	0.383

*significant at p-value <0.250

Simple logistic regression between independent variables and WTP. Variables having a p-value of less than 0.250 were included in the multivariate analysis. A higher p-value was set to avoid missing important variables associated with willingness to pay for the vaccine.

Table V: Predictors of WTP by multiple logistic regression

Variable	Coefficient, β	SE	AOR	95% CI		P value
				Lower	Upper	
Constant	0.425					
Age group (years)						
18 – 30	1.138	0.570	3.121	1.022	9.530	0.046*
31 – 40	0.957	0.385	2.603	1.223	5.538	0.013*
41 – 50	0.672	0.318	1.957	1.049	3.651	0.035*
51 and above	Ref					
Household income (MYR)						
Less than 4849 (B40)	Ref					
4,850 to 10,959 (M40)	0.740	0.302	2.096	1.160	3.788	0.014*
More than 10,960 (T20)	1.150	0.318	3.157	1.694	5.883	<0.001*

*significant at p-value <0.05, Nagelkerke R^2 = 7.7%

Predictors of WTP by multiple logistic regression. The model identified age group between 18 and 50 years and having a monthly household income above RM 4.850 were more willing to pay for the vaccine compared to respondents aged above 50 and having a lower monthly income.

The prediction model found that age group and monthly household income were the predictors of willingness to pay for the COVID-19 vaccine. Respondents from the age group 18 to 30 years, 31 to 40 years, and 41 to 50 years were found to be 3.121 times, 2.603 times, and 1.957 times, respectively, more likely willing to pay for the COVID-19 vaccine compared to respondents aged 51 years and above. Meanwhile, respondents with a household income of between MYR4,850 and 10,959 were 2.096 times, and incomes more than MYR10,960 and above were 3.157 times more willing to pay for the COVID-19 vaccine compared to respondents with a household income less than MYR4,849.

DISCUSSION

The results showed that 97.4% of the respondents agreed to be vaccinated. Early research on the vaccine in the Southeast Asia region by Wong et al. in Malaysia (11) and Harapan et al. in Indonesia (30) show that 94.3% and 93.4% of the respondents would accept vaccination. On the contrary, a survey conducted in the U.S. by (7) in May 2020 revealed a lower acceptance for the vaccine, 67.0% out of the 672 participants. This study's high acceptance rate was likely attributable to the fact that the respondents were from a suburban area and highly educated, as 80% received education at least at a degree level. These attributes could have enabled them to seek better information and increase their knowledge and confidence in vaccine safety and development, apart from constant health promotion by the government (31, 32). Also, the fact that data collection was done during the peak of the outbreak between May 25 and June 2, 2020, was another factor that could have influenced the

high acceptance rate, as the public were anxious with the progress of the pandemic.

As for knowledge, this study revealed that the respondents had sufficient knowledge of the disease's main symptoms and the necessary preventive practices that need to be taken, which was similar to the findings of the study by (33) which displayed the respondents had good knowledge regarding the effects of COVID-19 on health (65%) and the effects of the pandemic on the economy and employment (75%). Several other studies also show the association between good knowledge and positive acceptance of vaccines. For example, (34) indicated that good individual knowledge regarding the health outcomes following vaccination is associated with higher vaccine acceptance and WTP, while El-Elimat et al. (8) found that access to a reliable source of information regarding COVID-19 and the vaccine's potential to end the pandemic is crucial in shaping people's judgment on vaccine acceptance.

A high-risk perception for contracting COVID-19 infection would imply increased actions toward prevention practice, including the need to vaccinate (11). Results from this study were consistent when most respondents agreed or strongly agreed that COVID-19 could infect them and acknowledged the government's recommendations for addressing the crisis. Perception of a new intervention shapes people's acceptability towards it. For example, in Nigeria, the unsuccessful vaccination implementation of the polio vaccine was mainly shaped by wrong perceptions created by religious leaders or community members (35). Arbiol et al. (34), in their study assessing respondents' risk perception, demonstrated that a higher perception score is associated with better vaccine acceptance. This evidence supports the results of this study when respondents with better perception scores have a higher percentage of vaccine acceptability and WTP.

Following an assessment of acceptance of the COVID-19 vaccine, 478 respondents in this study were asked about the maximum monetary value they were willing to pay for it. The mean WTP was MYR141.05 (±98.70) (US$34.07, ±23.85). The result is comparable to an earlier local study where the mean WTP obtained was MYR134 (±79.20)(US$30.66 ±18.12) (11). The mean WTP in Indonesia was higher, US$57.20 (95%CI: US$54.56, US$59.85) (30). Meanwhile, an even higher value was recorded in South American countries, such as Ecuador, where the mean WTP for a vaccine ranged between US$147.61 and US$196.65 (25), and in Chile, US$184.72 (36).

This study demonstrated that most respondents were willing to pay out-of-pocket for the COVID-19 vaccine, and only a minority, 18.83% (90/478), stated they would instead acquire the vaccine for free. It is almost identical to what Harapan et al. (14) discovered when 16.10% of their respondents were not even willing to pay the lowest bid at the amount of US$15.47. The significance of the finding of this current study is that if the vaccine was mandated but not provided for free by the government, one in five of the studied population might not become vaccinated if the vaccine's price was more than US$24.17. Hence, achieving sustainable herd immunity would probably be jeopardised if financial subsidies are not provided to COVID-19 vaccination programs.

The results also discovered that younger respondents aged 18 to 30 years were three times more likely to pay for the vaccine than those who were older, aged 51 years and above. In addition, respondents from the age group 31 to 40 years and 41 to 50 years have odds of 2.603. and 1.957 times more willing to pay compared to the elder age group, 51 years and above. This finding was supported by Wang et al. (32), where older respondents were not willing to spend as much as younger groups for a vaccine dose. Additionally, the distribution of sufficient knowledge regarding COVID-19 in the age groups below 51 years combined (63.74%) was higher than respondents 51 years and above (61.24%). This reflects the contribution of knowledge towards a higher WTP, as Harapan et al. (30) explained.

Another predictor identified was respondents with household income between MYR4,850 and MYR10,959 were 2.096 and more than MYR10,960 and above were 3.157 times more likely to pay for the COVID-19 vaccine than those with household income less than MYR4,849. Equivalent to what previous studies have identified, individuals with better financial stability would have the price barrier removed and, consequently, better ability to pay (11, 14). It is expected that when Malaysians earn better and have the financial freedom to care for their health, the government could focus on other essential matters for development without undermining the country's health financing reform (37).

Professional and managerial occupation categories are often related to individuals with better knowledge and higher income status, hence their WTP for health. The result of a study in China assessing occupation as a predictor for self-health by Xie et al. (38) shows that income and education attainment had a more significant association with health compared to occupation. Variations between occupation categories in terms of income might be why this variable is not included in the final model, as the incomes for categories other than the professional and managerial categories might be higher (38). The respondents in this study are mainly individuals above 50 years old, and some might be pensioners or still in positions with a lucrative income. Moreover, respondents in the general worker and student category also show a high percentage of WTP. The variation of the result in their WTP could be why the occupation category was not a predictor of WTP for the COVID-19

vaccine.

Addressing study limitations, employing an online cross-sectional design may be subjected to non-response bias, as not all invitees responded to the questionnaire, which might limit the findings' generalizability to the broader population. Additionally, the snapshot nature of the study may not capture changes in attitudes and behaviours over time. The distribution of questionnaires during the peak of COVID-19 cases could have influenced respondents' perceptions and WTP. The study instruments, adapted from existing literature, may not fully capture the nuances of the target population's health beliefs and behaviours. Furthermore, the cluster sampling method, while practical, was hindered by lockdown restrictions, limiting direct engagement with community members and potentially contributing to the low response rate. Future research could address these limitations using more robust sampling techniques and measurement instruments.

CONCLUSION

The findings of this study reveal a strong positive sentiment towards the COVID-19 vaccine among residents of Bandar Baru Bangi. A remarkable 97.35% of respondents expressed willingness to accept the vaccine, with 81.17% indicating a willingness to pay an average of MYR141.05 (US$98.70) per dose. Notably, younger respondents (aged below 51 years) and higher-income earners showed a greater propensity to pay for the vaccine. However, the online sampling approach used in this study could not represent the entire urban population in the study areas. This limitation may exclude less tech-savvy populations, potentially biasing results toward higher-income or educated groups. Therefore, these results should be interpreted with caution, acknowledging this potential sampling bias.

These insights have significant implications for policymakers and public health officials in preparing for future pandemics. The high level of vaccine acceptance and willingness to pay observed in this study suggests strong vaccine demand, particularly among suburban and educated groups. To ensure equitable vaccine access and achieve herd immunity, strategic interventions such as vaccine subsidies or incentive programs are recommended to address barriers, including financial constraints and vaccine hesitancy. Leveraging these findings, policymakers can develop targeted strategies to enhance vaccine uptake and protect public health effectively.

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