

GETTING THE COVID-19 VACCINATION: EXPLORING THE MILLENNIALS AWARENESS

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Abstract: The COVID-19 pandemic has impacted individuals' well-being, economic stability, and the behavioural patterns observed in societies across the globe. Vaccinations play a pivotal role as a positive externality in preventing the spread of COVID-19. Given the prevailing economic circumstances, vaccination programmes for the common benefit of all, imposes a considerable financial burden on the government. This study estimates the millennials' willingness to pay (WTP) for the COVID-19 vaccine to mitigate its transmission, as well as to identify the factors that influence their WTP for the vaccine. This study employed the contingent valuation method (CVM) to calculate the WTP. This study utilised purposive sampling from the millennial demographic, with a specific age group target, i.e., 24 to 39 years old. The findings reveal that several factors have significantly influenced their WTP for the COVID-19 vaccine. These factors comprise individual income, education level, gender, and age. The calculated mean WTP using the Logit model is RM47.60 (US\$10.05) per individual. The estimated WTP for vaccination holds significant importance in the optimisation of resource allocation, understanding of the vaccination programme's cost-effectiveness, and formulation of well-informed decisions regarding public health policies and strategies that promote the welfare of both individuals and collective well-being.

Keywords: COVID-19, millennial, positive externality, vaccination, willingness to pay.

Introduction

The global landscape experienced significant transformations in the wake of the emergence of coronavirus disease 2019 (COVID-19). On March 11, 2020, the World Health Organisation (WHO) declared the COVID-19 outbreak a pandemic (Cerdeira & Garcia, 2021). COVID-19 is a highly infectious disease caused by a new coronavirus called severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).

It rapidly spread worldwide, affecting over 200 countries, including Malaysia. From January 3, 2020 to October 4, 2023, Malaysia reported 5,129,131 COVID-19 cases and 37,194 fatalities to the World Health Organisation (2023a). The first case of COVID-19 in Malaysia was reported on January 25, 2020, involving three Chinese

nationals who were visiting from Wuhan, China, the epicentre of the COVID-19 outbreaks.

The government started imposing curfews and quarantines through a series of Movement Control Orders (MCO) to prevent the spread of COVID-19 from March 18, 2020. These restrictions were modified to Conditional Movement Control Order (CMCO), the Recovery Movement Control Order (RMCO), and the Enhanced Movement Control Order (EMCO) depending on the country's pandemic situation from time to time.

The government remains committed to the National Recovery Plan (NRP) enforced on June 1, 2021, which is still in effect. On April 1, 2022, then Malaysian Health Minister,

Khairy Jamaludin, announced the transition to treating COVID-19 as endemic. Currently, only a small number of people have been infected with COVID-19, however, cases are continually being reported. The pandemic has significantly impacted people's lives, national security, physical and mental health, food safety, and the economy. It has changed the way society behaves and has become a global challenge.

The COVID-19 pandemic has caused significant challenges in various aspects of human life and has been associated with potential long-term symptoms (Fahriani *et al.*, 2021). When infections were at their peak, the Ministry of Health and the World Health Organisation (WHO) issued guidelines to the public on how to prevent COVID-19 infections, such as mandatory use of face masks, maintaining social distancing, closing public areas, and imposing curfews to ensure the safety of people during the pandemic. In instances of profound severity, hospitalisation and empiric antibiotic therapy with ventilation are advised (Tobaiqy *et al.*, 2020).

Hospitalised patients with COVID-19 are more susceptible to thromboembolic occurrences during and after hospitalisation (Ioannis *et al.*, 2023). The ongoing COVID-19 pandemic warrants continued adherence to protective measures in daily life as recommended by the WHO (World Health Organization, 2023b).

Pharmaceutical companies developed safe and effective vaccines to help end the pandemic. In Malaysia, a total of 312,390 doses of the first batch of COVID-19 vaccine from Pfizer-BioNTech arrived at Kuala Lumpur International Airport (KLIA) on February 21, 2021. As of October 31, 2023, the country has administered 72,871,577 vaccine doses for most Malaysian citizens, including

adolescents and children. After the vaccine was administered, the vaccinated population was monitored to ensure its safety and effectiveness. Any adverse effects from vaccination would be promptly studied and mitigated. According to Lurie *et al.*, (2020), vaccination is the most effective way to protect individuals against communicable diseases and confer lasting immunity.

The COVID-19 vaccine is effective in reducing the risk of infection and the negative impacts of the pandemic in the long run. Getting vaccinated is of utmost importance as it offers benefits not only to the individual but also to society. By receiving an effective vaccine, an individual can boost their immune system and prevent the virus from spreading. Widespread vaccination has benefits beyond individual protection, such as mitigating mortality rates and minimising work absences (Corey, 2021).

Malaysia obtained COVID-19 vaccines from Pfizer-BioNTech, AstraZeneca, Sinovac, Sputnik V, and CanSinoBIO. The WHO states a minimum efficacy rate of 50% for COVID-19 vaccines. Also, the introduction of booster doses is considered a strategic approach for the long-term containment of cross-border transmission and local outbreaks. The implementation of a comprehensive vaccination programme presents considerable financial and social obstacles, despite its critical importance for the well-being of the population (Zhou *et al.*, 2022).

Considering the ongoing economic condition, implementing vaccination programmes for a sizable population entails a significant financial burden on the government. The Malaysian government through MOH has spent billions of ringgit on COVID-19 management, including vaccines.

According to Malaysia National Health Accounts (MNHA) from the Planning Division, the Health Ministry reported that RM7,567 million was spent on COVID-19 in 2021, 9.7% of the total expenditure on health (TEH), and about RM5,788 million of that amounts came from the ministry. The government has spent around RM4,986 million for the vaccination programme and RM879 million for COVID-19-related treatment and contact tracing (MNHA, 2022; MOH, 2022). Malaysia is currently providing free COVID-19 vaccinations to the public. The government aims to achieve widespread vaccine coverage for population protection and create herd immunity.

This study addresses the importance of understanding millennial attitudes towards COVID-19 vaccination that is crucial for achieving herd immunity. Millennials' awareness influences vaccine uptake, impacting public health outcomes. Moreover, mass vaccination efforts strain government finances, necessitating efficient resource allocation. Investigating millennials' perceptions contributes valuable insights for designing effective vaccination campaigns while considering the fiscal challenges governments face in promoting public health.

Willingness to Pay for Vaccination to Prevent the Spread of Virus

In measuring the acceptance and success of the vaccination programme, it is crucial to assess the value of the service. Previous studies have shown the WTP for vaccination programmes among various populations (Lai *et al.*, 2020; Chun-Lian, 2023; Jia-Xiang, 2023). The findings of the WTP studies indicate that government bodies and healthcare authorities must factor in the socioeconomic characteristics and quality of healthcare services when devising an efficacious

WTP studies indicate that government bodies and healthcare authorities must factor in the socioeconomic characteristics and quality of healthcare services when devising an efficacious healthcare system (Rajamoorthy *et al.*, 2019).

The WTP refers to the maximum amount one is willing to pay for a specific good, product, or service. Typically, WTP is determined using the Stated Preference method, which involves the Contingent Valuation Method (CVM) or Choice Modelling (CM).

The WTP studies for COVID-19 vaccines differ across various populations. For instance, in Pakistan, most of the respondents were willing to accept the COVID-19 vaccine for their children, whereas a significant number were unwilling to pay (Khezar, 2023). In Taiwan, many parents were willing to pay for their children's COVID-19 vaccine, and this willingness was linked to their WTP for the vaccine (Chun-Lian, 2023).

While in Iran, a significant number of participants were willing to pay for a COVID-19 vaccine with a calculated WTP mean of US\$60.13. Those with higher income, education level, and risk perception were more willing to pay (Moslem *et al.*, 2023). In China, the estimated mean WTP for the booster dose was CNY 149 ($\pm$ CNY 197), and the median WTP was CNY 80 (Hui *et al.*, 2022).

It has been observed that the willingness of higher education institution students to get vaccinated against COVID-19 varies. According to a study conducted among Grade 12 Humanities and Social Sciences students in the Philippines, there was a significant positive correlation between the willingness to get vaccinated and the overall attitude towards COVID-19 (Athena *et al.*, 2022). An investigation conducted within a college campus community revealed that a virtual

and the overall attitude towards COVID-19 (Athena *et al.*, 2022). An investigation conducted within a college campus community revealed that a virtual educational session facilitated by pharmacy students has effectively enhanced COVID-19 vaccine awareness, and improved willingness to get the vaccine (Fever *et al.*, 2022).

However, an American study found that college students' COVID-19 vaccine hesitancy was influenced by race (highest among African Americans), political affiliation (highest among non-Democrats), undergraduate or international student status, limited travel during the pandemic, and prior COVID-19 infection (Michele *et al.*, 2023).

Estimation studies on the WTP provide decision-makers with a better understanding of people's preferences, which can be used in policy design (Dias-Godói, 2021). Hence, considering the financial constraints and limited availability of medical supplies in Malaysia as a developing country, this study aims to assess how much millennials are willing to pay for the COVID-19 vaccine. Additionally, the study seeks to identify the factors influencing their WTP for the vaccine.

Materials and Methods

Data were obtained from a survey to observe knowledge, perception, and WTP for the COVID-19 vaccine. The study was conducted at Universiti Malaysia Terengganu, Malaysia, and focused on the millennial demographic population. A survey-based approach comprised both face-to-face data collection

and an online survey platform. The online survey was conducted using Google Forms and respondents were selected from specific communities. To maintain the respondents' anonymity, they were permitted to complete the questionnaire only once via their personal WhatsApp accounts. The survey was carried out for three weeks in April 2023. A snowball sampling technique was employed, commencing with convenient sampling among friends, colleagues, and their respective families working on campus. Subsequently, the questionnaire was disseminated to other participants.

Study Designs

The study's participation was voluntary and without any form of incentive. Eligibility for involvement in the survey was limited to individuals between 24 and 39 years old who could read Bahasa Melayu. The questionnaire comprised three sections, (i) knowledge and experience of the COVID-19 vaccine, (ii) estimation of the WTP, and (iii) socio-demographic information. A pilot study was conducted on 20 participants to test and refine the questionnaire, confirming its feasibility and accuracy. There were minor changes required. To ensure the reliability of the scales used, Cronbach's alpha was calculated, revealing satisfactory internal consistency. This pilot test not only refined the survey instrument but also provided valuable insights into respondents' willingness to pay for the COVID-19 vaccine, setting the stage for the main study. Cronbach's alpha reliability test results related to the price bids survey are shown in Table 1.

Table 1: Cronbach's alpha reliability test results for price bids responses

Price Bid (RM)	Corrected Item-total Correlation	Cronbach's Alpha if Item Deleted
20	0.65	0.78
40	0.70	0.76
60	0.68	0.77
80	0.59	0.80
100	0.55	0.81

The overall Cronbach's alpha of 0.79 indicates good internal consistency among items, with positive item-total correlations suggesting they effectively measure respondents' willingness to pay. This reliability analysis reinforces the robustness of the CVM used in the study. Before participating in the final field survey, respondents must complete a consent form following ethical research practices. The collected data were gathered using measures that prioritize anonymity and confidentiality, thereby safeguarding the privacy of the respondents.

Sampling Procedures

The respondents were strictly those within the campus millennial demographic, also known as Generation Y, aged between 24 and 39 years old and born between 1981 and 1996. They included postgraduate students, university staff and contractors working on campus. A purposive sampling was used to target a subgroup of the population with certain characteristics.

To achieve the target, a snowball sampling technique was initiated with a few eligible individuals who fulfilled the criteria.

From there, the researcher managed to obtain more individuals who also met the criteria, thus creating a growing network of participants for the study.

In addition, millennials have been relying on multiple sources, including social media, news outlets and healthcare professionals, for accurate and reliable information. Besides, millennials are seen as having a high level of trust in scientific research and evidence-based medical practices, making them more likely to get vaccinated against COVID-19. Thus, this study would observe millennials' perceptions and their WTP for the COVID-19 vaccine, to curb the spread of the pandemic.

Assessing Willingness to Pay for the COVID-19 Vaccine

This study employed a contingent valuation method (CVM) to calculate WTP in obtaining the COVID-19 vaccine as a preventive measure against a disease caused by SARS-CoV-2. The determination of the WTP is crucial in calculating expenses for COVID-19 vaccination among millennials. The CVM is one of the methods to estimate the benefits of this preventive vaccine in the form of monetary value. The estimation of the WTP via CVM can be signified as follows:

$$WTP = f(X, \varepsilon) \quad (1)$$

where;

WTP = Individuals' willingness to pay for non-market goods/services.

X = A set of variables that defines the characteristics of the non-market product/service.

ε = An error term that is a statistical term used to signify the unexplained variation or randomness in individuals' responses.

Based on the CVM, respondents were asked to state the amount they would pay for COVID-19 vaccination. The respondents would be randomly offered a price bid and must answer "Yes" or "No" to the bid. When an individual is requested to pay a specific

amount of money to protect themselves against the outbreak of an infectious disease by receiving the COVID-19 vaccine, they have the option to either accept or decline the proposed price bid.

Logit Model

To gauge the potential respondents' WTP for a COVID-19 vaccine, they were presented with an initial price bid and asked to indicate their level of agreement. The WTP can be determined using a logit model to map "Yes" and "No" responses of 1 and 0, respectively, to the offered price bids in a questionnaire. The dependent (explained) variable was millennials' WTP for the COVID-19

vaccination. The question posed was "Would you be willing to pay MYR x (price bid) for the COVID-19 vaccine to prevent the spread of the ongoing pandemic?". For respondents who responded with "Yes" the code assigned was 1 while 0 would be assigned to the negative response. In this case, when estimating WTP using a logit model, the basic form of the model is expressed in Equation 2:

$$P(Y = 1 | X) = \frac{e^{(x\beta)}}{1 + e^{(x\beta)}} \quad (2)$$

where;

- $P(Y = 1 | X)$ = The probability of a millennial choosing the option associated with positive responses, such as willingness to pay for the COVID-19 vaccine.
- X = A vector of independent variables or attributes that influences the millennial's willingness to pay.
- β = A vector of coefficients that are assessed through statistical techniques.

To estimate WTP for a specific attribute, the researchers calculated the change in probability associated with a one-unit change

one-unit change in that attribute. The following formula can be used to estimate WTP for a continuous attribute (such as price):

$$WTP = \frac{\text{Coefficient of the Variable}}{-\text{Coefficient of Price}} \quad (3)$$

While holding the price constant, Equation 3 offers the estimated amount that individuals are willing to pay for a one-unit change in a particular attribute. In the study, the data regression was conducted with the statistical software STATA Version 14.2 to estimate the coefficients and determine the willingness to pay (WTP).

Results and Discussions

Out of 220 surveyed individuals, only 120 agreed to participate in the study, resulting in a participation rate of 54.5%. Some questionnaires were excluded because they were ineligible or had missing information. Table 2 presents the sociodemographic analysis and participants' experience of COVID-19 involved in the final survey of the campus.

Table 2: Sociodemographic analysis and participants' experience of the COVID-19

Variables	Categories	Frequency (N = 120)	Percentages (%)
Gender	Male	55	45.8
	Female	65	54.2
Age (years)	24-29	89	74.2
	30-35	20	16.6
	36-39	11	9.2
Race	Malay	118	98.3
	Chinese	2	1.7
	Indian	0	0
Marital status	Married	34	28.3
	Single	85	70.8
	Widowed	1	0.9
Education	No formal education	0	0
	Primary school	0	0
	Secondary school	19	15.8
	Diploma/Matriculation	47	39.2
	Degree	44	36.7
	Master's	7	5.8
	PhD	2	1.7
	Others	1	0.9
Occupation	University staff	11	9.2
	Private-sector staff	46	38.3
	Business	12	10
	Students	35	29.7
	Others	16	13.3
Income (RM)	Below 1,000	34	28.3
	1,001-3,000	66	55
	3,001-5,000	10	8.3
	5,001-7,000	6	5
	7,001 and above	4	3.4
I have received the COVID-19 vaccine	Yes	119	99.17
	No	1	0.83
Have you been vaccinated? If so, how many doses did you get?	No	1	0.83
	Dose 1	2	1.67
	Dose 2	50	41.67
	Booster Dose 1	52	43.33
	Booster Dose 2	15	12.5
Which COVID-19 vaccine did you get?	Pfizer	81	67.5
	Sinovac	30	25.0
	AstraZeneca	8	6.7
	Others	1	0.8
Did you experience any negative effects from the COVID-19 vaccine?	Yes	42	35
	No	51	42.5
	Uncertain	27	22.5

Your clinic or hospital visits during COVID-19 vs. before	Increase	21	17.5
	Decrease	32	26.67
	No Changes	67	55.83
Are you avoiding clinics and hospitals due to worry about COVID-19 infection?	Yes	71	59.17
	No	49	49

According to the campus survey, the male participants accounted for 45.8% (55) of the total sample, while the remaining 54.2% (65) were female (Table 2). Most participants were aged 24 to 29 (74.2%) and mostly postgraduate students. Most participants, approximately 70.8%, were identified as single, indicating a likelihood of being students. Approximately, 39.2% of the participants have successfully fulfilled the requirements for a diploma or matriculation. Regarding individual income, a majority of 55% reported earning RM1,001 to RM3,000 per month, with RM1,000 = US\$211.42.

A total of 99.17% reported receiving the COVID-19 vaccine through the government's free National Immunisation Programme (NIP). The program aims to achieve the highest possible immunisation rate among both citizens and non-citizens residing in Malaysia. There was a significant level of acceptance for COVID-19 vaccines among the study participants in Malaysia, with a notable proportion expressing their intention to receive vaccination (Ke-Yan et al. 2021). The first phase of the vaccination programme involved frontline workers, while subsequent phases focused on high-risk groups and the adult population. Many participants, 43.33%, have received the first dose of the booster vaccine. These booster vaccine doses, commonly called third doses, are administered to those who have already completed the full vaccination against COVID-19. Booster COVID-19 vaccines are crucial for increasing coverage and reducing severe illness risk (Min et al. 2023). About 67.5% of participants received the Pfizer vaccine from NIP. This finding tallies with the

data stating that most Malaysians received the Pfizer vaccine through the NIP (Ministry of Health Malaysia, 2023).

Approximately 42.5% of respondents reported no negative side effects from the COVID-19 vaccine. A study found no evidence that the COVID-19 vaccine caused miscarriage, or had effects on breast milk production, libido, dietary habits, menstrual cycles, or premenstrual syndrome (PMS) (Wali et al., 2023).

A total of 35% of those who received the vaccine reported experiencing negative effects such as fever, muscle pain and nausea. The common side effects of the vaccine comprise mild to moderate pain at the injection site, redness, hives, rash, swelling or tenderness of lymph nodes, headache, pain in muscles and joints, nausea, and vomiting (Katarzyna, 2021).

According to the survey results, 55.83% of respondents did not experience any significant changes in their frequency of clinic or hospital visits during the COVID-19 pandemic compared with the pre-pandemic period. There was variation in the frequency of clinic visits before and after COVID-19 across the different studies.

A study found that daily paediatric subspecialty visits experienced a significant decline, dropping from an average of 2,066 patients per day to merely 1,000 patients per day during the study period (Chelsea et al., 2020). Besides, this study found that 59.17% of participants avoided clinics and hospitals due to worries about COVID-19 infection. Manaswi and Choudhary (2021) found that

individuals exhibited reluctance to visit hospitals during the COVID-19 pandemic unless they presented with severe symptoms. Telemedicine offers medical consultation from a distance, effectively eliminating the need for in-person visits (Shaundreal *et al.*, 2023).

Perceptions Towards the COVID-19 Vaccination

In the survey, the participants were questioned about their overall thoughts and opinions regarding the COVID-19 vaccine. This section utilised a 5-point Likert scale where 1 = strongly disagree, 2 = disagree, 3 = uncertain,

4 = agree, and 5 = strongly agree. Approximately 51.7% of respondents agreed that taking the vaccine is crucial for boosting the body's immunity. It has been suggested that using COVID-19 vaccine boosters may be a viable method for enhancing immunity (Jennifer & Adam, 2021). About 56.7% of participants agreed that the COVID-19 vaccine is crucial for the safety of others. This vaccine is considered necessary because it offers protection to third parties who cannot receive the vaccine themselves but can still benefit from the immunity of those who were vaccinated.

Table 3: Participants' opinions on the COVID-19 vaccination

Statements	Levels				
	1	2	3	4	5
i. The COVID-19 vaccine is crucial to boost my body's immunity.	2 2%	2 2%	34 28.3%	62 51.7%	20 16.7%
ii. The COVID-19 vaccine is crucial to protect oneself and others from infection.	1 1%	3 2.5%	32 26.7%	68 56.7%	16 13.3%
iii. The COVID-19 vaccine is crucial for promoting better health and securing the well-being of future generations.	2 2%	3 2.5%	26 21.7%	70 58.3%	19 15.8%
iv. The COVID-19 vaccine is crucial for the community to witness its effectiveness.	2 2%	5 4.2%	28 23.3%	61 50.8%	24 20%
v. The COVID-19 vaccine is crucial for ensuring future health and safety.	2 2%	2 2%	36 30%	61 50.8%	19 15.8%
vi. Getting inadequate doses of the COVID-19 vaccine can cause significant economic losses, as it disrupts daily activities.	1 1%	5 4.2%	37 30.8%	59 49.2%	18 15%
vii. The COVID-19 vaccine is crucial for the economy to function while following SOPs.	1 1%	2 2%	30 25%	61 50.8%	26 21.7%

Next, about 58.3% agreed that the COVID-19 vaccine is crucial for better health and well-being of future generations. Getting vaccinated is a preventive measure against the consequences of COVID-19, including severe illness and death, even among the younger population. This action protects the future generation's well-being by preventing the disease's potentially catastrophic health implications.

Subsequently, around 50.8% of respondents agreed that it is important to receive the COVID-19 vaccine so that others can assess the efficacy of the injections that others have received. The participants believed that evidence of vaccine effectiveness is crucial for increasing trust in the vaccine. Developing safe and effective COVID-19 vaccines is vital in controlling the pandemic, preventing loss of life and reducing economic losses (Arifur *et al.*, 2021).

About 50.8% of participants agreed that the COVID-19 vaccine is crucial for ensuring future health. All communities desire a safe and prosperous environment for the next generation, free from danger. Approximately 49.2% agreed that getting inadequate doses of the COVID-19 vaccine can disrupt daily activities and cause economic loss for the country.

According to a study, it has been found that neutralising the Omicron variant of

COVID-19 requires the administration of at least three doses of either the AstraZeneca, Pfizer or Moderna vaccines (Nagendrakumar *et al.*, 2022). According to the survey, about 50.8% of the respondents agreed that receiving the COVID-19 vaccine is crucial for the country's economy to resume its normal operations despite the SOP. This is because the vaccine can help achieve herd immunity, leading to the full reopening of the economy.

Table 4: Distribution of participants' responses to price bids

Price Bids (RM)	Yes (1)		No (0)	
	Frequency	Percentages (%)	Frequency	Percentages (%)
20	13	54.2	11	45.8
40	14	58.3	10	41.7
60	12	50	12	50
80	8	33.3	16	66.7
100	5	20.8	19	79.2
Total	52	43.3	68	56.7

Note: RM10.00 equivalent to US\$2.11.

This study presents different price bids to the participants as everyone has different preferences and WTP for a particular good or service. By offering various price bids, researchers can better understand the variation in values among the respondents. This approach allows for a more accurate estimation of the distribution of WTP values within the sample. By providing a range of prices, CVM aims to reduce hypothetical bias and obtain more realistic valuation estimates. This study offered five price bids: RM20.00, RM40.00, RM60.00, RM80.00, and RM100.00 (Table 4). The COVID-19 vaccine price bids presented were based on estimates from previous studies (Wong *et al.*, 2020; Acob *et al.*, 2021; Hui *et al.*, 2022).

In general, as the offered price bids increased, more participants tended to reject the price bids. For instance, only five participants responded "Yes" to a bid of RM100.00, while the remaining 19 rejected the price. In this case, it has been demonstrated that millennials' WTP decreases as the bid price increases. The law of demand states that the demand (willingness to pay) decreases as the price increases. This implies that an increase in price leads to a decrease in the probability of individuals paying for vaccines (Cerdeira & Garcia, 2021).

Table 5: Logit model regression for millennials' WTP

Variables	Coefficient	Std. Err.	Sig.
Male	23.9967	11.7832	0.042***
Age	-5.8720	2.0723	0.005***
Individual income	0.0088	0.00404	0.029***
Education	16.6108	6.7418	0.014***
Constant	123.912	58.0853	0.033***

Note: *** significant at the 5% level, ** significant at the 10% level, * significant at the 15% level.

The findings presented in Table 5 indicate that every variable examined is statistically significant at a 5% level. However, it should be noted that the “age” variable exhibited an inverse relationship with the WTP probability for the vaccine, achieving statistical significance at the 5% level.

In this case, it is believed that the WTP for the COVID-19 vaccine decreases as age increases. It indicates a negative correlation between age and WTP for the COVID-19 vaccine. Specifically, as age increases, the WTP decreases. Holding all other variables constant, for each additional year of age, the log-odds of being willing to pay for the vaccine decrease by approximately 5.87. Esen (2021) revealed a notable inclination among young individuals to receive the COVID-19 vaccination.

Based on sociodemographic characteristics, it is observed that males exhibit a WTP for the COVID-19 vaccine. This shows that the males are willing to pay for the COVID-19 vaccine compared to females. Individuals belonging to the millennial generation with more purchasing power and educational attainment exhibit a WTP for the vaccine.

The present study supports previous studies that found a positive association between income, education levels, and individuals' WTP for a vaccine (Cerdeira &

Garcia, 2021; Wong *et al.*, 2020). Hence, individuals who earn more have a stronger WTP for vaccination, suggesting from a public policy standpoint, that it may be appropriate to provide the vaccine free of charge to low-income populations while allowing higher income populations to bear the expense.

According to the computed mean, WTP is RM47.60 (US\$10.4), with a positive correlation between WTP and male gender, income level, and educational attainment. The estimation of WTP is quite consistent with the findings of Wong *et al.* (2020) and Amirah *et al.* (2020).

Conclusions

The COVID-19 pandemic has resulted in profound economic, social, and public health consequences, and remains a substantial global concern. The implementation of COVID-19 vaccinations, consisting of booster doses, has been undertaken as a comprehensive strategy to ensure long-term public health safety.

In Malaysia, COVID-19 vaccinations remain accessible to eligible individuals without charge but cannot choose the vaccine type. An individual who wants a preferred vaccine can go to a private clinic or hospital that provides the vaccine at cost.

Vaccination is commonly perceived as a public good owing to its characteristics of

being non-excludable and non-rivalrous, as well as its capacity to foster herd immunity. Financing free vaccination programmes can burden government budgets, especially in low and middle-income nations. Khairy Jamaluddin, the former Minister of Science, Technology, and Innovation mentioned that the government spent RM77.35 on COVID-19 vaccines for each Malaysian, which is for 26.5 million individuals involving a total cost of RM2.05 billion (Hafizi, 2020). The government also sets the maximum wholesale and retail price among private clinics and hospitals that sell the COVID-19 vaccine at RM62.00 and RM77.00, respectively for the vaccine produced by Sinovac, and RM49.00 and RM61.00 for Sinopharm (Ministry of Health, 2022).

Gaining a comprehensive understanding of the WTP for vaccination could improve the allocation of resources, enable cost-benefit analysis, and support the formulation of efficacious vaccination strategies. The millennials have exhibited an approximate WTP of RM47.60 for the COVID-19 vaccination. The observed correlations between the participants and sociodemographic factors, including male gender, age, individual income, and education level, were seen as significant.

These results may contribute to the knowledge of millennials' COVID-19 acceptance and WTP. The results indicate that in the future, policymakers should improve the design of public health policies, financial schemes and vaccination programmes that require out-of-pocket expenses. Moreover, it is imperative to consider subsidies for the COVID-19 vaccine among low-income groups while planning interventions for vaccination.

Based on public willingness to pay for the COVID-19 vaccine and considering out-of-pocket expenses, governments should

implement policies to alleviate financial burdens while ensuring widespread vaccine coverage. This may involve subsidising vaccination costs for economically disadvantaged groups and implementing progressive pricing models based on income. Besides, transparent communication about vaccine pricing and financial assistance programmes is crucial to build trust and encourage vaccine uptake among millennials and the broader population.

Many individuals usually assume their vaccination choices are personal health considerations, although it is important to recognise that the advantages of vaccination extend beyond the individual to encompass the broader community. Government action, such as the implementation of public health campaigns and the enforcement of vaccination requirements, may be deemed necessary to attain optimal vaccination rates and effectively maximise the positive externalities associated with widespread vaccination.

The allocation of public funds towards vaccination programmes can be rationalised based on the positive externalities they provide, as the broader community reaps the advantages of diminished disease transmission. It is important to acknowledge certain limitations of this study when interpreting the findings. The generalisability of the findings to broader populations or other universities is uncertain.

Additionally, future research must consider other significant factors, including but not limited to, such as COVID-19 exposure, individual health conditions, chronic disease, and peer pressure.

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Conflict of Interest Statement

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare absence of conflicting interests with the funders.

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