Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Short Report

Factors influencing COVID-19 vaccination intention among university students: A cross-sectional study in Malaysia

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ABSTRACT

Vaccination is crucial in controlling the spread of the coronavirus disease 2019 (COVID-19) that triggered the pandemic, but herd immunity can only work with high vaccination coverage in the population. This study aims to measure the COVID-19 knowledge level and determine the factors influencing COVID-19 vaccination intention among university students in Malaysia. A cross-sectional online survey was carried out with 1,274 Malaysian university students in July 2021. Univariate and multivariate analyses were employed to examine the relationships between the study variables. Results showed that the majority of university students had an acceptable level of knowledge of COVID-19. The knowledge, risk perception of COVID-19, social norms, and perceived benefit of COVID-19 vaccination were positively associated with vaccination intention. However, perceived trust in information sources of COVID-19 vaccination and the government's response to COVID-19 did not affect the university students' desire to receive the vaccination. These findings are essential for health policymakers and healthcare providers to implement evidence-based interventions to increase COVID-19 vaccination uptake among university students.

1. Introduction

"No one will ever be truly safe until everyone is safe." This was a loud and clear message from the Deputy Secretary-General of the United Nations, Amina Mohammed, on handling the coronavirus disease 2019 (COVID-19) pandemic crisis [1]. This message is not limited in its use to describe the global economic crisis caused by the COVID-19 pandemic but can also describe the progress of the COVID-19 vaccination program [2]. A high-level action is urgently required to increase the vaccination rate to control the spread of COVID-19 caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Although preventive measures of non-pharmaceutical interventions (NPIs), such as social distancing, personal protection, and environmental and travel measures, can suppress the spread of COVID-19 [3], herd immunity is frequently cited as the desired panacea to stop the COVID-19 pandemic [4]. Many countries' regulatory affairs agencies have authorized or approved several vaccines for emergency use against COVID-19 [5,6]. However, a sizeable population across the globe is still undecided about whether to receive the vaccine or not. For example, a global survey reported that only 71.5% of the respondents were somewhat likely to take a COVID-19 vaccine [7]. Yamey and colleagues found that 2.8 million people remained entirely unvaccinated [8]. Therefore, the failure to increase access to vaccines by more people in all countries is the principal reason the virus is still winning [9].

Many colleges and universities are starting the fall semester at total capacity, with residential colleges full of students, courses held

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in-person, and various physical events resumed. Hence, vaccination is the only tool to keep students safe and COVID-19 at bay. For instance, in the United States, more than 1,000 public and private colleges and universities require their students and employees to be vaccinated against COVID-19 before returning to campus for the fall semester of 2021 [10]. Canadian colleges and universities have also adopted mandatory vaccination policies [11]. In Malaysia, similar policies are implemented; only fully vaccinated students, academic staff, and non-academic staff are allowed to enter the campus [12]. Despite concerns about the need for immunisation among university students, some students are hesitant to get the jab. Recognizing the difficulties in persuading these vaccine-resistant students to be vaccinated, an essential step forward is to understand the factors influencing vaccination intention. However, in the current literature, there remain critical gaps. First, our literature search, involving databases such as PubMed, Google Scholar, and Scopus, did not yield any relevant Malaysia-specific studies. Past studies primarily focused on Western contexts [13,14]. Due to vast differences in contexts and cultures, these findings are of limited generalizability to the situation in Malaysia. Malaysia is a multi-ethnic and cultural country, which comprises ethnic Bumiputra (70%), Chinese (22%), Indians (7%), and others (1%) [15]. Thus, different ethnicity has different beliefs. Second, among the limited literature on contributing factors of vaccination intention among university students, past studies heavily focused on demographic factors (e.g., age, education, and gender), and personal factors, such as knowledge of vaccines [16], while comparatively, sparse research explored influences at other levels, such as risk perception, trust in information sources, and government response. Therefore, to fill these research gaps, the current study aims to measure COVID-19 knowledge level and determine personal factors influencing COVID-19 vaccination intention among university students.

2. Methods

2.1. Ethical approval and recruitment procedure

The survey questionnaire, via a Google Forms weblink, was distributed in July 2021 by the authors and representatives of participating universities through social networking applications and email blasting services to recruit respondents. First, stratified random sampling was used to select the universities. Specifically, six main regions were identified, namely: (1) northern region, (2) central region, (3) southern region, (4) east coast, (5) Sabah, and (6) Sarawak. Next, within each region, one public university and one private university were randomly selected when the student population in each university was more than 10,000. However, 42 out of 53 private universities in Malaysia are located in the northern and central regions, and some regions do not have any private universities [17]. Moreover, only the private universities in these two regions have more than 10,000 students. Hence, two private universities (i.e., one each from the northern and central regions) were selected to represent the sample of university students from private institutions for this study. Thirdly, respondents were recruited among the students from the selected universities regardless of their enrolment in matriculation, foundation, diploma, bachelor, master, or doctorate programs.

Given that the focus of this study was on university students, respondents who were not from the participating universities, were not presently enrolled in any of the levels mentioned above, or had graduated from university were excluded from the study. In addition, a snowballing method was adopted whereby each participating university email-blasted the weblink of the questionnaire to their students to increase the sample size. Before data collection, this study was approved by the Scientific and Ethical Review Committee of Universiti Tunku Abdul Rahman, Malaysia (Ref no: U/SERC/123/2021). Informed consent from each respondent was presumedly given when they proceeded through the survey questionnaire after reading the first page of the study information and purpose.

The sample size was calculated using the Kish formula with a confidence interval level of 95% and a 4% margin for error. The COVID-19 vaccine acceptability was 52.8% [13]. Therefore, the sample size in this study was estimated to be 1,274 after adjusting for a 20% drop-out rate and 40% non-response rate [18].

2.2. Measurements

The survey questionnaire was written in British English and consisted of eight main themes assessing: (1) knowledge of COVID-19; (2) risk perception of COVID-19; (3) social norm of COVID-19 vaccination; (4) perceived benefits of COVID-19 vaccination; (5) perceived trust on information sources about COVID-19 vaccination; (6) perception towards government's response to COVID-19 pandemic; (7) COVID-19 vaccination intention and (8) demographic characteristics.

To measure knowledge about COVID-19, respondents were asked to state true or false for 13 items adapted from a previous study [19]. The respondents were tested based on their knowledge of clinical presentations (items 1–4), transmission routes (items 5–8), and prevention and control (items 9–13) of COVID-19. Respondents were provided with three response options, "true," "false," or "not sure," to these questions. A correct response to an item was assigned 1 point, while an incorrect/not sure response was given 0 points. The maximum total score ranged from 0 to 13, with a higher score indicating a better knowledge of COVID-19.

The risk perception of COVID-19 was measured based on respondents' perceived seriousness of the COVID-19 pandemic, perceived likelihood of contracting the virus themselves, and the likelihood of their family, friends, and people in their country contracting the virus to understand their present level of anxiety about the virus [20]. Respondents were asked to respond to seven items using a 4-point scale ranging from 1 (Strongly Disagree) to 4 (Strongly Agree). The conceptualization of Dryhurst et al. [20] was adopted to measure this construct by modifying items from studies that examined risk perception in previous pandemics [21,22]. Examples included "The problem of the COVID-19 outbreak is important to me" and "I am worried that I will be infected with COVID-19 in the future". To treat this as a continuous variable, all items were summed and averaged to create a composite score, with a higher score indicating a higher risk perception.

The respondents were asked about their family and friends' support if they intended to be vaccinated to measure the social norm of COVID-19 vaccination. Three items were adapted from Shmueli et al. [23], which were "If I tell my parents that I intend to get vaccinated against COVID-19 when a vaccine is available, they will respond positively", "If I tell my friends and relatives that I intend to get vaccinated against COVID-19 when a vaccine is available, they will respond positively", and "Most of my friends will support the COVID-19 vaccine". A 4-point scale was used, ranging from 1 = "Strongly Disagree" to 4 = "Strongly Agree". The responses were summed up and averaged, with a higher score showing higher social norms.

Perceived benefits of COVID-19 vaccination were measured with two items adapted from Lin et al. [24], including "Vaccination is a good idea because I feel less worried about catching COVID-19" and "Vaccination decreases my chance of getting COVID-19 or its complications". A 4-point scale was used, ranging from 1 = "Strongly Disagree" to 4 = "Strongly Agree". We averaged the responses and created a composite score. A higher score indicates a higher perceived benefit of COVID-19 vaccination.

To assess the perceived trust in information sources for COVID-19 vaccination, six items adapted from Soveri et al. were used [25], including "I trust what medical doctors say about COVID-19 vaccines" and "I trust what scientists say about COVID-19 vaccines". A 4-point scale was used, ranging from 1 = "Strongly Disagree" to 4 = "Strongly Agree". All responses were summed and averaged to create a single index, with a higher score indicating higher trust in information sources.

To assess students' opinions towards the government's response to the COVID-19 pandemic, the COVID-SCORE-10 instrument was adopted [26]. Items included, for example, "The government helped me and my family meet our daily needs during the COVID-19 pandemic in terms of income, food, and shelter", and "The government communicated clearly to ensure that every-one had the information they needed to protect themselves and others from COVID-19, regardless of socioeconomic level, migrant status, ethnicity or language". The responses were on a 4-point scale, ranging from 1 = Strongly Disagree to 4 = Strongly Agree. The score of each item was averaged to create a composite score. A higher score indicates a positive response toward the government managing COVID-19 in Malaysia.

On a four-point scale (1 = "Strongly Disagree", 4 = "Strongly Agree"), we used two items derived from Kelly et al. [27] to measure COVID-19 vaccination intention: "If I can get a vaccine for COVID-19 today, I would like to get vaccinated" and "If general public in Malaysia can get a vaccine for COVID-19 today, I would like to encourage my family and friends to get vaccinated". Finally, we averaged the responses and created a composite score. A higher score indicates a higher intention to get vaccinated.

Demographics were treated as control variables to reduce potential confounding effects. Demographic questions included age, gender, ethnicity, religion, university, study field, monthly household income, and current study year.

2.3. Reliability test and data analysis

Before data collection, a pilot test was conducted to test the validity of the content and reliability of the questionnaire with Cronbach's alpha. The results showed that the Cronbach alpha for all items used in that particular instrument used in this study ranged from 0.755 to 0.969. The results are reliable according to Ursachi et al., where the range of Cronbach's alpha of 0.6 to 0.7 indicates an acceptable level of reliability, and 0.8 or greater shows a perfect level of reliability [28].

Both descriptive and inferential statistics were applied in the data analysis. Using the Statistical Package for Social Sciences (SPSS) Version 26.0, frequency, percentages, means, standard deviation, and *t*-test were presented as descriptive statistics to answer the research objectives. To determine the factors influencing COVID-19 vaccination intention, we used hierarchical ordinary least squares regression to examine the incremental assessment of R^2 in each stage and the relative effects of variables while accounting for those entered simultaneously or in previous steps by entering variables in distinct blocks [29]. For example, we entered the intention to vaccinate in the first block, along with demographic and other control variables. Meanwhile, knowledge, risk perception, social norms, perceived benefit, perceived trust in information sources, and government response were entered in the second block.

3. Results

3.1. Demographic characteristics

The characteristics of the demographic variables are displayed in Table 1. The respondents ranged from 17 to 55 years (M = 24.3 ± 5.92), with 67.03% identifying as females, which concurs with the general population in the universities in Malaysia where there are significantly more female students than male students (i.e., 57.31% female and 42.69% male) [30]. In addition, the statistics show that 45.75% of respondents were from the Malay ethnic group, and most of the respondents studied in public universities (80.46%).

3.2. Descriptive statistics

In the context of the knowledge level of COVID-19, 13 questions with 1 point awarded for one correct answer, the average knowledge score for participants was 10.79 ± 1.7 (range 0–13). Approximately 84.07% of participants obtained scores above 10, representing a good knowledge of COVID-19. Among the 13 questions on knowledge of COVID-19, most participants knew that people who had contact with an infected person should be immediately isolated for 14 days (97.96%) (Table 2). However, nearly half of the participants answered either wrongly or were unsure of the differences between the common cold and COVID-19. Besides that, only 51.88% of participants correctly answered when asked if eating and touching wild animals could result in a COVID-19 infection. In comparison between the mean knowledge score for students who are in health sciences-related programs (11.02 ± 1.47) versus non-health sciences students (10.66 ± 1.8), there is a statistically significant difference (P = 0.000).

Table 1
Demographic characteristics of participants (N = 1,274).

Characteristic	Category	N (%)
Age (years)	Mean ± SD	24.32 ± 5.92
	Median (IQR)	22 (21, 25)
	Range	17–55
Gender	Male	420 (32.97)
	Female	854 (67.03)
Ethnicity	Malay	583 (45.75)
	Chinese	413 (32.42)
	Indian	75 (5.89)
	Bumiputera Sabah/Sarawak	140 (10.99)
	Other	63 (4.95)
Religion	Islam	679 (53.31)
	Buddhism	299 (23.47)
	Hinduism	64 (5.02)
	Christianity	163 (12.79)
	Atheist	25 (1.96)
	Other	44 (3.45)
University	Public	1,025 (80.46)
	Private	249 (19.54)
Study field	Health Sciences	463 (36.34)
	Non-health Sciences	811 (63.66)
Current study year	Matriculation/Foundation	45 (3.53)
	Diploma	57 (4.47)
	Bachelor Year 1	263 (20.65)
	Bachelor Year 2	205 (16.09)
	Bachelor Year 3	199 (15.62)
	Bachelor Year 4	132 (10.36)
	Bachelor Year 5	10 (0.79)
	Masters	186 (14.60)
	Doctorate	150 (11.77)
	Other	27 (2.12)

SD = standard deviation; IQR = interquartile range.

In this study, the analysis showed that the mean for risk perception of COVID-19 was 3.58 ± 0.56. The value indicated that the participants had a high-risk perception of COVID-19. Similarly, high mean values were also observed in social norm (3.66 ± 0.52), perceived benefits (3.50 ± 0.61), and perceived trust in information sources on COVID-19 vaccination (3.18 ± 0.53). However, when measuring their view on the government's response to the COVID-19 pandemic, the mean was 2.72 ± 0.62. The mean value indicated that the participants were divided in their support of the government's response. In this study, we also surveyed the COVID-19 vaccination intention of the participants. Among 1,274 participants, 97.25% (1,239) agreed or strongly agreed to get vaccinated if they can get a vaccine for COVID-19 today. Supplementary 1 describes the proportion of participants in terms of their risk perception of COVID-19, social norms, perceived benefits, perceived trust in information sources of COVID-19 vaccination, the government's response to the COVID-19 pandemic, and COVID-19 vaccination intention.

3.3. Bivariate correlation analysis

Before determining the factors influencing COVID-19 vaccination intention, this study performed a bivariate correlation analysis to

Table 2
Respondent's knowledge of COVID-19.

	Questions	Total participants (N = 1,274)		Health sciences (N = 463)		Non-health sciences (N = 811)		*P*-value
		Answered correctly N (%)	Answered wrongly N (%)	Answered correctly N (%)	Answered wrongly N (%)	Answered correctly N (%)	Answered wrongly N (%)	
1	The main clinical symptoms of COVID-19 are fever, fatigue, dry cough, and body aches.	1,215 (95.37)	59 (4.63)	439 (94.82)	24 (5.18)	776 (95.68)	35 (4.32)	0.479
2	Unlike the common cold, stuffy nose, runny nose, and sneezing are less common in persons infected with SARS-CoV-2.	652 (51.18)	622 (48.82)	232 (50.11)	231 (49.89)	420 (51.79)	391 (48.21)	0.564
3	Currently, there is no effective cure for COVID-19, but early symptomatic and supportive treatment can help most patients recover from the infection.	1,123 (88.15)	151 (11.85)	426 (92.01)	37 (7.99)	697 (85.94)	114 (14.06)	0.001
4	Not all persons with COVID-19 will develop severe cases. Only those who are elderly and have chronic illnesses are more likely to be severe cases.	890 (69.86)	384 (30.14)	350 (75.59)	113 (24.41)	540 (66.58)	271 (33.42)	0.001
5	Eating or touching wild animals could result in the infection of SARS-CoV-2.	661 (51.88)	613 (48.12)	254 (54.86)	209 (45.14)	407 (50.18)	404 (49.82)	0.108
6	Persons with COVID-19 cannot spread the virus to others if they do not have a fever.	1,131 (88.78)	143 (11.22)	418 (90.28)	45 (9.72)	713 (87.92)	98 (12.08)	0.199
7	SARS-CoV-2 spreads via respiratory droplets of infected individuals.	1,155 (90.66)	119 (9.34)	437 (94.38)	26 (5.62)	718 (88.53)	93 (11.47)	0.001
8	SARS-CoV-2 is airborne.	954 (74.88)	320 (25.12)	351 (75.81)	112 (24.19)	603 (74.35)	208 (25.65)	0.564
9	Ordinary residents can wear face masks to prevent the infection with SARS-CoV-2.	1,188 (93.25)	86 (6.75)	439 (94.82)	24 (5.18)	749 (92.36)	62 (7.64)	0.092
10	It is unnecessary for children and young adults to take measures to prevent the infection with SARS-CoV-2.	1,062 (83.36)	212 (16.64)	395 (85.31)	68 (14.69)	667 (82.24)	144 (17.76)	0.157
11	To prevent the infection of SARS-CoV-2, individuals should avoid going to crowded places and taking public transportation.	1,233 (96.78)	41 (3.22)	450 (97.19)	13 (2.81)	783 (96.55)	28 (3.45)	0.531
12	Isolation and treatment of people infected with SARS-CoV-2 are effective ways to reduce the spread of the virus.	1,233 (96.78)	41 (3.22)	455 (98.27)	8 (1.73)	778 (95.93)	33 (4.07)	0.023
13	People who have contact with someone infected with SARS-CoV-2 should be isolated immediately in a proper place. In general, the isolation period is 14 days.	1,248 (97.96)	26 (2.04)	457 (98.70)	6 (1.30)	791 (97.53)	20 (2.47)	0.156

Abbreviations: COVID-19, coronavirus disease 2019; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

examine the relationships between study variables. Results showed that intention to get vaccinated had a medium effect and was positively correlated with social norms (r = 0.68, $P < 0.01$) and perceived benefit (r = 0.60, $P < 0.01$). However, there was a significant correlation between intention to get vaccinated and knowledge score (r = 0.26, $P < 0.01$), risk perception (r = 0.42, $P < 0.01$), perceived trust (r = 0.45, $P < 0.01$), government response (r = 0.11, $P < 0.01$) as well as a few demographics variables, but the magnitudes of these correlations were weak. In the models where intention to get vaccinated was the dependent variable, the multicollinearity tests showed tolerance values well above zero and variance inflation factor (VIF) values well below the conventional cut-off of 10 [29]. Supplementary 2 presents the correlation between study variables and VIF values.

3.4. Predictors of vaccination intention

Table 3 presents the results of regression models predicting the intention to get vaccinated among university students. Demographic variables were controlled and entered in block one, while main study variables were entered in block two. Overall, demographic variables accounted for a minimal amount of variance in intention to get vaccinated (6.5%), and only gender (β = -0.08, P = 0.004), year of study (β = 0.09, P = 0.030) and ethnicity (β_{Malay} = 0.48, P = 0.000; $\beta_{Chinese}$ = 0.40, P = 0.000; β_{Indian} = 0.18, P = 0.000; $\beta_{Bumiputera}$ = 0.30, P = 0.000) were significant in predicting the intention to get vaccinated.

After controlling the demographic variables, the main predictors accounted for 57.5% of the variance in intention with an R-squared change of 0.51 ($P < 0.000$). Therefore, knowledge of COVID-19 was positively associated with vaccination intention (β = 0.08, t = 3.91, P = 0.000). Similarly, risk perception was a predictor for vaccination intention (β = 0.14, t = 6.58, P = 0.000). Students with a higher perceived risk of contracting COVID-19 were more likely to get vaccinated. The regression analysis also showed that social norms would be positively associated with vaccination intention (β = 0.44, t = 17.76, P = 0.000). In other words, students' will to get inoculated against COVID-19 was somehow influenced by their family, friends, and those who are important to them. In this study, we also found that the perceived benefit of COVID-19 vaccines was positively related to students' vaccination intention (β = 0.28, t = 11.70, P = 0.000), whereby the better understanding the students have on the benefits of getting vaccinated, the more willing they are to get inoculated.

However, regression analysis found that perceived trust in information sources on COVID-19 vaccination did not influence vaccination desire among university students (β = 0.05, t = 1.88, P = 0.06). Similarly, in the context of the role of the government in responding to the COVID-19 pandemic on the students' vaccination intention, the finding showed that government responses to the COVID-19 pandemic in the country did not have a significant association with students' vaccination intention (β = -0.02, t = -1.10, P = 0.27). The government response and efforts to address COVID-19 did not predict students' desire to vaccinate against SARS-CoV-2.

4. Discussion

4.1. Knowledge of COVID-19

This study has shown that most university students know about COVID-19. Lessons learned during the SARS outbreak in 2003 informed us that people's understanding of infectious diseases is related to their level of fear [31]. Studies showed that the general public and university students with correspondingly high knowledge about COVID-19 exhibited positive attitudes and low-risk practices [32]. In our study, health sciences students had more knowledge about COVID-19 than non-health sciences students. The same observation was also reported among several universities in United Arab Emirates

Table 3
Hierarchical ordinary least squares regression predicting vaccination intention.

Characteristics	Block 1		Block 2	
	β	t	β	t
Age	−0.007	−1.71	−0.001	−0.03
Male (vs female)	−0.080	−2.93**	−0.001	−0.45
Ethnicity (vs Other)				
Malay	0.480	6.28***	0.080	1.72
Chinese	0.400	5.15***	0.100	1.86
Indian	0.180	3.81***	0.050	1.48
Bumiputera Sabah/Sarawak	0.300	6.06***	0.060	1.89
Religion (vs non-Muslim)	0.080	1.07	0.006	0.122
University (vs private)	−0.010	−0.23	−0.020	−0.82
Study field (vs non-health sciences)	0.030	1.13	0.020	1.04
Study year	0.090	2.18*	0.020	0.57
Household income per month	0.020	0.71	−0.020	−0.85
Knowledge			0.080	3.91***
Risk perception			0.140	6.58***
Social norm			0.440	17.76***
Perceived benefit			0.280	11.70***
Perceived trust			0.050	1.88
Government response			−0.020	−1.10
	Adj R^2 = 0.056		Adj R^2 = 0.569	
	$F(11, 1208)$ = 7.63***		ΔR^2 = 0.510	
			$F(17, 1202)$ = 95.75***	

*$P < 0.05$. **$P < 0.01$. ***$P < 0.001$.

[33] and Jordan [16]. The knowledge category was significantly associated with the primary discipline of the respondents. Compared to their non-health sciences counterparts, health sciences students have access to various information, including trustworthy medical platforms, healthcare experts, government media briefings, and university newsletters, which may explain their high understanding of COVID-19 [34].

Notably, despite the health sciences students having more knowledge about COVID-19 than non-health sciences students, there was no statistical difference between the two groups of students in their vaccination intention (Table 2). The results demonstrated that the students were willing to be vaccinated despite being from diverse groups, which is likely due to the government's vaccination regime, in which all members of the general public are required to receive vaccination; otherwise, their movement would be restricted [35]. Furthermore, more and more countries require tourists to produce proof of vaccination upon entry into their countries [36,37]. As a result, regardless of the student group, all students are willing to be vaccinated.

4.2. Predictors of vaccination intention

Based on the KAP (knowledge, attitudes, and practices) theory, individuals' knowledge could affect their adherence to COVID-19 control measures and vaccination intention. Understanding of infectious diseases is related to their level of fear [31], including willingness to take the vaccination. In this study, the finding concurred with the theory that knowledge of COVID-19 was positively associated with vaccination intention. Similarly, Sengupta et al. also demonstrated that knowledge of COVID-19 directly impacted the attitude and intention toward vaccination among the general public of India [38].

Second, examining the students' risk perception of COVID-19 and its association with vaccination intention is essential because it is logical that when people believe they are at risk for a disease (i.e., infected by SARS-CoV-2), they are more likely to engage in risk-lowering behaviors (e.g., get vaccinated) [39]. In public health, risk perception is one of the most influential constructs in predicting health decision-making [40]. Our findings suggest that students perceive a higher risk of COVID-19 to be more desirable to get vaccinated. Consistent with recent studies, SARS-CoV-2 is a novel virus that causes psychological distress among people due to anxieties and fears [41,42], resulting in increased vaccination uptake [43]. In line with the risk-as-feelings model, these results confirmed the role of risk perception on the judgment and decision-making by individuals' instinctive and intuitive reactions to danger [44], in this case, COVID-19.

Third, results revealed that students' COVID-19 vaccination intention was associated with social norms. This finding is consistent with prior research indicating that students' decisions to be immunised will be influenced by those they see as vital to them. Hasmah et al. suggested that the "people around him/her and their opinions" matter more than the "individual's opinion" in influencing the behavioral outcome [45]. These people hold high esteem, such as our parents, friends or peers, religious figures, health care providers, etc. Thus, social norm plays a role in influencing one's intention to engage in a specific behavior due to a person's desire to "please" and comply with these people's expectations.

Fourth, this study found that a high perception of the benefits of receiving the vaccine was one of the crucial constructs influencing a definite intention for COVID-19 vaccination and concurs with findings from previous reports [46,47]. Furthermore, the positive association between perceived benefit and intention to vaccinate can be observed in H1N1 [48] and flu influenza [49] vaccinations. Therefore, to enhance vaccination reception, public health intervention programs need to focus on increasing the perception of the benefits of vaccination and reducing the identified barriers [24]. Besides that, evidence-based initiatives can include employing effective communication to educate students and highlighting the importance of community protection [50], which, in this context, is a vaccine benefit.

Fifth, lessons learned from previous infectious disease outbreaks and public health emergencies, including HIV/AIDS, H1N1, SARS, MERS, and Ebola, reminded us that trust in sources of information and guidance is fundamental to disease control and vaccination [51]. However, our findings found that perceived trust in COVID-19 information sources did not predict vaccine intention. The COVID-19 pandemic is an unprecedented event and has created many uncertainties. The scientific knowledge of this pandemic continues to evolve, resulting in a massive flow of health information with rapidly changing information, mixed messages, and inconsistencies in recommendations which, in turn, makes health communication during the

pandemic difficult [52]. A study revealed that 57.6% of the respondents in one survey reported being exposed to conspiratorial misinformation, such as COVID-19 vaccines being harmful and dangerous [53]. Thus, it might lead to university students conserving trustworthy COVID-19 information sources.

Finally, a finding of interest was that responses and efforts from the Malaysian government in addressing COVID-19 did not predict or increase the university students' desire to be vaccinated against the pandemic. This possibility is likely due to the students lacking trust in the government [54], especially when the government officers themselves breached the COVID-19 rules [55]. The general public felt that the government did not practise what it preached, and therefore there was no reason for the public to do the same. The communication survey instrument utilized by our established government was developed to demonstrate satisfactory validity and help governments engage constituents in current and future efforts to control COVID-19 more effectively [26]. During crises, particularly epidemics, significant impediments to aligning individual and group interests arise, which pose a challenge to adopting necessary behavioural modifications to avoid disease spread [56]. In this context, governments must effectively communicate the collective benefits of adopting evidence-based strategies. Public faith in a government is a critical component of this process [57], and any mistrust towards the government can raise vaccine hesitancy [58].

4.3. Limitations and future directions

It is vital to recognize study limitations when interpreting the results. This survey was conducted in July 2021, during which we did not know that a booster shot would be required to boost the immunity of COVID-19-vaccinated individuals against the virus. With the reduced efficacy of the vaccine against new variants and the implementation of a booster shot in the vaccination program [59], it is crucial to track changing public opinion on getting a vaccine now and those planning for one in the future. Besides, this study was carried out by studying vaccination intentions that may not translate into actual behaviours. Furthermore, the current study used self-reported data. Therefore, participants may have answered the questions based on what they perceived was expected from them.

Future studies should look into how changing infection severity affects vaccination intentions. For example, a recent study suggests that vaccine-hesitant and the unvaccinated are less concerned about the coronavirus and its Delta and Omicron variants and have less faith in the safety and effectiveness of the vaccines than those who have been vaccinated [60]. In addition, some countries have declared their intention to start treating COVID-19 like other endemic diseases, such as seasonal flu [61], which can influence the vaccination intention of the public.

5. Conclusions

Developing an efficient COVID-19 vaccine is critical in halting the spread of SARS-CoV-2, but herd immunity requires high coverage of immunized people. This study provides survey data on the level of knowledge on COVID-19 and the intention of university students to be vaccinated against this pandemic. The majority of university students have an acceptable level of knowledge of COVID-19. Nevertheless, health sciences students are more knowledgeable about COVID-19 than non-health sciences students. In addition, there are positive associations between knowledge, risk perception of COVID-19, social norms, and perceived benefit of the COVID-19 vaccine with vaccination intention. However, in the present study, perceived trust in information sources and the government's response and efforts in addressing COVID-19 does not affect the university students' desire to be vaccinated against the pandemic. These findings are essential for health policymakers and healthcare providers to implement evidence-based interventions to increase COVID-19 vaccination uptake among university students.

Ethics statement

This study was approved by the Scientific and Ethical Review Committee of Universiti Tunku Abdul Rahman, Malaysia (Ref no: U/SERC/123/2021). Informed consent from each respondent was presumedly given when they proceeded through the survey questionnaire after reading the first page of the study information and purpose.

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Conflict of interest statement

The authors declare that there are no conflicts of interest.

Author contributions

Chee Yin Wong: Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing, Visualization. **Jen Sern Tham:** Conceptualization, Methodology, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Supervision, Project administration. **Chai Nien Foo:** Conceptualization, Methodology, Validation, Formal analysis, Project administration, Writing – original draft. **Foong Leng Ng:** Conceptualization, Project administration. **Saleha Shahar:** Resources, Project administration. **Mohd Nizam Zahary:** Resources, Project administration. **Mohd Nazri Ismail:** Resources, Project administration. **Cheng Siang Tan:** Resources, Project administration. **Boon Peng Hoh:** Resources, Project administration. **Subbiah Vijay Kumar:** Resources, Project administration. **Yang Mooi Lim:** Conceptualization, Writing – original draft, Writing – review & editing, Software, Project administration.

Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.bsheal.2022.12.005.

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