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Acceptability for COVID-19 vaccination: perspectives from Muslims

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ABSTRACT

This study aims to assess COVID-19 vaccine acceptance among Muslims in Malaysia. A cross-sectional internet-based survey was to determine acceptance of COVID-19 vaccine. Other influential factors, namely socio-demographics, COVID-19 experience, self-perceived level of religiosity, support in immunization, COVID-19 immunization attitudes, and health fatalistic beliefs (measured using the Helpless Inevitability Subscale of the Religious Health Fatalism Questionnaire, RHFQ-HI) were investigated. The majority reported a definite intent to receive the COVID-19 vaccine (57.3%; 95% CI 55.0–59.6) followed by a probable intent (42.7%; 95% CI 40.4–45.0%). COVID-19 immunization attitudes measured by attitudinal barriers to vaccination scores were found to be the strongest influence of COVID-19 vaccination intent, whereby participants who have lower attitudinal barrier scores reported higher COVID-19 vaccination intent (OR = 6.75 ; 95% CI 5.20–8.75). Although religious health fatalism was not significantly associated with vaccination intent, a significantly higher proportion of participants with score 4–9 (61.9%) in the RHFQ-HI reported intent to receive COVID-19 vaccine than those with a score of 10–20 (53.5%), $p < .001$. Intervention for people with skeptical attitudes toward COVID-19 vaccination is warranted.

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



Introduction

The COVID-19 pandemic poses a great challenge to the population worldwide including the Muslims. An increasing number of Muslim-majority countries across the globe were stricken badly by the outbreak. As of early May 2020, Turkey, Saudi Arabia, Pakistan and Iran were among the hardest-hit Muslim countries by the coronavirus pandemic. Malaysia is a Muslim majority country in the Southeast Asia region that was equally impacted greatly by the COVID-19 outbreak. Malaysia announced the first three cases of COVID-19 on 25 January 2020. On 3 April 2020, Malaysia had the highest number of known infections in Southeast Asia, with 3116 confirmed cases and 50 deaths,¹ and a large number of the cases have been linked to a *tabligh* (religious) gathering.

Vaccine acceptance has always been a challenge in many Muslim countries, and the Muslim religion has been associated with lower vaccination coverage.² Rejection of immunization on religious grounds is still strong among many Muslims, especially in more conservative Muslim societies. Doubts over the halal (kosher) status of vaccine is well-known to be the major concern of Muslims rejecting immunizations.^{3,4} Religious health fatalism, the belief that an individual's health outcome is predetermined or purposed by a higher power and not within the individual's control, has been a widely used theory in understanding a variety of health and illness-seeking behaviors, as well as an

inhibitor to participation in health promotion programmes, health-care utilization and health decision-making.^{5–8} Muslim, in particular, is a religion with many in the community whose health behaviors are influenced greatly by fatalistic beliefs.⁹ Studies reported that some Muslims view God as the one who ultimately controls health and illness and believe that God can provide a cure.^{10,11} Such belief has been reported to greatly influence Muslim health behaviors to the extent that it poses great challenges and ethical dilemmas to health care.¹² To the best of our knowledge, religious health fatalism has never been used to investigate vaccine intention among Muslims. Muslims rejecting immunization on religious grounds have been an ongoing concern.^{13,14} Examining the intersection of religious health fatalism and intention to receive a hypothetical COVID-19 vaccine will provide insights into how these beliefs impact on the Islamic perspective on COVID-19 vaccination.

Malaysia is a Muslim majority country. Prior to the COVID-19 pandemic, the National Immunization Program (NIP) in Malaysia provides free vaccination services to protect Malaysian children from infectious diseases including hepatitis B, poliomyelitis, tuberculosis, Haemophilus influenzae type b, measles, mumps, rubella, Japanese encephalitis (JE) and human papillomavirus (HPV).¹⁵ The reported immunization coverage of Malaysia by 2018 was 100% for DPT -HIB (third dose) and polio vaccine (third dose), near 100% for BCG (98.43%) and

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Hepatitis B (99.16%), and over 80% for MMR (87.75%) and HPV (82.23%).¹⁶ As religious affiliation has been known as potential barrier in some Muslim countries,² uncovering the acceptability of the COVID-19 vaccine is important to inform health policy decisions to improve vaccination coverage in the future. Therefore, the main aim of this study was to assess COVID-19 vaccine acceptance among Muslims in Malaysia. Influential factors of vaccine acceptance, namely socio-demographics, COVID-19 experience, self-perceived level of religiosity, support in immunization, COVID-19 immunization attitudes, and health fatalistic beliefs were explored.

Methods

Study participants and survey design

We commenced a cross-sectional, web-based anonymous survey using an online questionnaire. A website version of the questionnaire was developed using the Google Forms platform. The researchers used the social network platforms of Facebook, Instagram, and WhatsApp to disseminate the Google Forms survey to their network members. Network members were requested to distribute the invitation to all their contacts i.e., snowball distribution of the survey invitation and share on social media. The inclusion criteria were that the respondents were Malaysian Muslim residents who were between 18 and 70 years of age. Taking into consideration that online and mobile users are younger and higher education level, network members were encouraged to disseminate survey link to people of older age and of lower education level to enhance representativeness. The respondents were informed that their participation was voluntary and consent was implied through their completion of the questionnaire. The questionnaire was developed in English and was then translated into Bahasa Malaysia, the national language of Malaysia. A standard forward and back-translation procedure was followed. Questions were presented bilingually in English and Bahasa Malaysia. A panel of experts that consisted of multidisciplinary academicians and researchers validated the content of the questionnaire. Pilot testing was conducted on 20 persons to test the clarity of the items and feasibility of the answer options before the administration of the questionnaire.

Instruments

The questionnaire of the survey, which consists of questions that assessed 1) demographic backgrounds, self-perceived level of religiosity, support in immunization and COVID-19 experience; 2) immunization attitudes; 3) religious health fatalism; and 4) intention to receive a COVID-19 vaccine.

Socio-Demographics, religiosity, support in immunization and COVID-19 experience

Personal details, including age, gender, marital status, occupation, and average monthly household income, were queried. The participants were asked to rate their level of religiosity on a four-point scale ('not at all', 'slightly', 'moderately', 'very'). Support in immunization was categorized as 1) pro-vaccine ('You/your

child(ren) were vaccinated with all the recommended vaccines in the Malaysian National Immunization Programme at the recommended age-intervals';¹⁷ 2) vaccine-hesitant ('You/your child(ren) were unvaccinated for at least one of the recommended vaccines or you/your child(ren) were not vaccinated at all but were still uncertain about the decision of vaccination'); and 3) anti-vaxxer ('You/your child(ren) were not vaccinated with all the recommended vaccines at the recommended age-intervals'). The question on COVID-19 experience asked participants whether they have ever been infected with COVID-19 and know of any close acquaintances such as friends, neighbors or colleagues who have been infected with COVID-19.

COVID-19 immunization attitudes

COVID-19 immunization attitudes were measured by self-developed attitudinal barriers to COVID-19 vaccination questions (a 4-item rating) that probed the perceived barriers to COVID-19 vaccination. Question 1: 'I will not take the vaccine unless the vaccine is certified halal'. Question 2: 'I will take the vaccine because we are in the COVID-19 crisis/emergency situation whereby no alternative medicine is available. Question 3: 'I will not take the COVID-19 vaccine as the new vaccine may not be safe and effective'. Question 4: 'I believe the COVID-19 vaccine is not necessary as there are other alternatives'. The response options were 'strongly agree', 'agree', 'disagree' or 'strongly disagree'. The question items were scored on a scale from 1 (strongly disagree) to 4 (strongly agree), then summed to create a total scale score. Question 2 was reverse-scored. The possible total attitudinal barriers to vaccination scores ranged from 4 to 16, with higher scores representing higher barriers to COVID-19 vaccination.

Religious health fatalism

Religious health fatalisms were measured by the Helpless Inevitability Subscale of the Religious Health Fatalism Questionnaire (RHFQ-HI).^{5,7} The RHFQ-HI is designed to measure the belief that God, not the individual, has control over health outcomes.⁷ The RHFQ-HI was reported to have a high coefficient alpha (Cronbach alpha reliability coefficient of .89).⁷ The smaller number of items in the RHFQ-HI is ideal to be used in self-administered online survey to reduce the number of drop-outs. The RHFQ-HI was found to have a Cronbach alpha reliability coefficient. The response options were 'strongly agree', 'agree', 'neutral', 'disagree' or 'strongly disagree'. The question items were scored on a scale from 1 (strongly disagree) to 5 (strongly agree), then summed to create a total scale score. The possible total religious health fatalism score ranged from 4 to 20, with higher scores representing a higher level of religious health fatalism.

Intention to receive a COVID-19 vaccine

The intention to accept a COVID-19 vaccine was measured using a one-item question (If a vaccine against COVID-19 is available on the market, would you take it?) on a four-point scale ('definitely not' to 'yes, definitely').

All the items in the questionnaire underwent face and content validity by a panel of several experts that consist of academicians, researchers and clinicians to ensure the relevance and clarity of the questions. After amendments, the questionnaire was pilot-tested on randomly sampled lay public who were not included in the study.

Ethical considerations

This study was approved by the University of Malaya Research Ethics Committee (UMREC). Approval code: UM.TNC2/UMREC – 887.

Sample size calculation

The calculated sample size was 385 based on a normal approximation to the binomial distribution with a finite population correction applied,¹⁸ assuming an observer proportion of respondents selecting a specific response option of 50%, a 95% confidence level, and a margin of error of 5%, and population size of 17.4 million Muslim in Malaysia.¹⁹ The sample size was multiplied by the predicted design effect of two to account for the use of convenience sampling and an online survey.²⁰ Hence, the minimum survey sample size was 770 (385×2).

Statistical analysis

The reliability of the self-developed attitudinal barriers to COVID-19 vaccination and RHFQ-HI were evaluated by assessing the internal consistency of the items representing the scores. The four items for attitudinal barriers and the RHFQ-HI scores had a reliability (Cronbach's α) of .606 and .493, respectively.

Frequency tables, charts and proportions were used for data summarization. The proportion and its respective 95% confidence interval (CI) were calculated. The Pearson chi-square test

was used to test whether there were statistically significant differences in vaccination intent and the independent variables in the univariate analyses. We ran multivariable logistic regression analysis to evaluate factors associated with the definite intention to take the COVID-19 vaccine (1 = Definitely yes; 0 = Probably yes/probably not/definitely not). The independent variables which have been found to be significant ($p < .05$) were entered into the multivariable model. The model fit of multivariable logistic regression analysis was assessed using the Hosmer–Lemeshow goodness-of-fit test.²¹ The Hosmer-Lemeshow statistic indicated a poor fit if the significance value is less than .05. All statistical analyses were performed using the Statistical Package for the Social Sciences, version 20.0 (IBM Corp., Armonk, NY, USA).

Results

Demographics, religiosity, support in immunization and COVID-19 experience

The survey link was disseminated from April 29 to 10 May 2020, and a total of 1,856 complete responses were received and included in the analyses. Table 1 shows the demographics of our study participants compared with the general adults population in Malaysia.²² Our study population has a slightly higher proportion of females and participants from the bottom 40% (B40) household income range,²³ and the Southern region. As shown in the first and second columns of Table 2, the study respondents were in the age group of 18 to 30 years old (27.3%) and 31–40 years old (32.5%). The study had a higher representation of females (62.1%), married participants (73.4%), and participants of professional and managerial occupations (56.1%). The proportion of the household income of the study participants was almost equally distributed among all the categories. The study received respondents from all the states in Malaysia, nonetheless, the higher proportion of the participants were from the

Table 1. Comparison of demographic characteristics of the study population and the general adults population in Malaysia, 2019.

Characteristics	n	% Study population, n=1856	% Total population, n= 24510400 *
Age group (years)			
18-29	431	23.2	38.0
30-39	636	34.3	22.0
40-49	343	18.5	15.3
≥50	446	24.0	24.7
Gender			
Male	704	37.9	51.6
Female	1152	62.1	41.4
Average monthly household income (MYR) (Income category group) †‡			
Below MYR4850 (B40)	928	50.1	16.0
MYR4850– 10,959 (M40)	580	31.3	37.2
MYR 19,060 and above (T20)	347	18.7	46.8
Region‡			
Northern	504	27.2	20.9
Central	192	10.3	29.7
East coast	207	11.2	13.8
Southern	799	43.0	14.5
Borneo	154	8.3	21.1

a*Total number of adults 18 to 79 years of age as of December 31, 2019 [23].

†Three category of income groups: Top 20% (T20), Middle 40% (M40), and Bottom 40% (B40) in Malaysia [23].

‡1 MYR = .2 USD.

‡Northern region (Perlis, Kedah, Perak, Penang); Central (Wilayah Persekutuan Kuala Lumpur, Selangor, Negeri Sembilan, Putrajaya); East coast (Terengganu, Kelantan, Pahang); Southern (Melaka, Johor); Borneo (Sabah, Sarawak, Labuan).

Table 2. Demographic characteristics of participants and factors associated with COVID-19 vaccination intent (N = 1856).

	Univariable analysis			Multivariable analysis	
	N(%)	Definitely yes (n=1064)	COVID-19 vaccination intent (n=792) Probably yes/Probably not/Definitely not	p-value	Probably yes/Probably not/Definitely not OR (95%CI)
Socio-demographics					
Age group (years)					
18-30	507 (27.3)	301 (59.4)	206 (40.6)		1.50 (1.03-2.20)*
31-40	603 (32.5)	374 (62.0)	229 (38.0)	0.002	1.11 (.82-1.51)
41-50	342 (18.4)	181 (52.9)	161 (47.1)		0.97 (.70-1.35)
>50	404 (21.8)	208 (51.5)	196 (48.5)		Ref
Gender					
Male	704 (37.9)	401 (57.0)	303 (43.0)	0.809	
Female	1152 (62.1)	663 (57.6)	489 (42.4)		
Marital status					
Never married	494 (26.6)	269 (54.5)	225 (45.5)		
Ever married	1362 (73.4)	795 (58.4)	567 (41.6)	0.137	
Occupation type					
Professional and managerial	1042 (56.1)	646 (62.0)	396 (38.0)		1.10 (.80-1.51)
Skilled worker/Unskilled worker	282 (15.2)	156 (55.3)	126 (44.7)		1.04 (.71-1.52)
Student	217 (11.7)	105 (48.4)	112 (51.6)	p < .001	0.76 (.47-1.23)
Retired/Housewife/Unemployed	315 (17.0)	157 (49.8)	158 (50.2)		Ref
Average monthly household income (MYR)					
2000 and below	311 (16.8)	138 (44.4)	173 (55.6)		Ref
2001-4000	402 (21.7)	228 (56.7)	174 (43.3)	p < .001	1.40 (.97-2.01)
4001-8000	608 (32.8)	374 (61.5)	234 (38.5)		1.90 (1.33-2.72)***
8001 and above	535 (28.8)	324 (60.6)	211 (39.4)		1.68 (1.14-2.45)**
Region#					
Northern	504 (27.2)	305 (60.5)	199 (39.5)		
Central	192 (10.3)	117 (60.9)	75 (39.1)		
East coast	207 (11.2)	110 (53.1)	97 (46.9)	0.180	
Southern	799 (43.0)	451 (56.4)	348 (43.6)		
Borneo	154 (8.3)	81 (52.6)	73 (47.4)		
Religiosity					
Not religious/Slightly/Moderately religious	627 (33.8)	347 (55.3)	280 (44.7)	0.234	
Very religious	1229 (66.2)	717 (58.3)	512 (41.7)		
Support in immunization					
Vaccine-hesitant/anti-vaxxer	222 (12.0)	59 (26.6)	163 (73.4)		Ref
Pro vaccine	1534 (88.0)	1005 (61.5)	629 (38.5)	p < .001	2.76 (1.97-3.87)***
COVID-19 experience					
Yes	629 (33.9)	361 (57.4)	268 (42.6)	1.000	
No	1227 (66.1)	703 (57.3)	524 (42.7)		
Immunization attitudes					
Total attitudinal barriers score					
Score 4-8	618 (33.3)	529 (85.6)	89 (14.4)		6.75 (5.20-8.75)***
Score 9-16	1238 (66.7)	535 (43.2)	703 (56.8)	p < .001	Ref
Religious health fatalism					
Total RHFQ-HI score					
Score 4-9	852 (45.9)	527 (61.9)	325 (38.1)		0.94 (.76-1.16)
Score 10-20	1004 (54.1)	537 (53.5)	467 (46.5)	p < .001	Ref

Notes: *p < .05**p < .01, ***p < .001.

Notes: Hosmer-Lemeshow test, chi-square: 4.885, p-value: .770; Nagelkerke R²: .261.

Notes: #Northern region (Perlis, Kedah, Perak, Penang); Central (Wilayah Persekutuan Kuala Lumpur, Selangor, Negeri Sembilan, Putrajaya); East coast (Terengganu, Kelantan, Pahang); Southern (Melaka, Johor); Borneo (Sabah, Sarawak, Labuan).

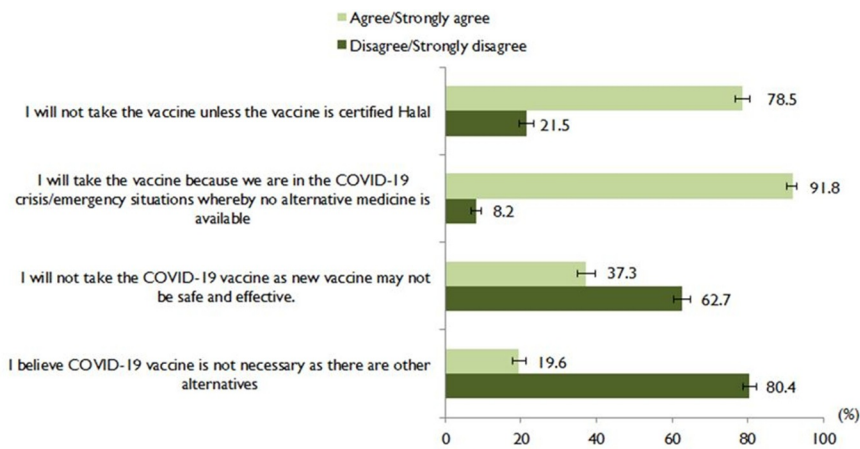


Figure 1. Attitudinal barriers to COVID-19 vaccination (N = 1856).

southern (43.0%) and northern (27.2%) regions. Most of the study participants perceived their level of religiosity to be very religious (66.2%). Only .5% (n = 10) of the study participants reported that they have ever been infected with COVID-19 and 33.9% (n = 629) reported to have close acquaintances who have been infected with COVID-19. A total of 12% (n = 222) identified themselves as vaccine-hesitant (n = 184) and anti-vaxxer (n = 28).

COVID-19 immunization attitudes

Figure 1 shows the results of the attitudinal barriers to COVID-19 vaccination. A high proportion (78.5%; 95% CI 76.6–80.4%) reported agree/strongly agree that they will not take the vaccine unless the vaccine is certified halal. A very high proportion (91.8%; 95% CI 90.4–93.0%) reported that they will take the vaccine in the event of an emergency situation where no alternative medicine is available. Only 19.6% (95% CI 17.8–21.4) reported agree/strongly agree that COVID-19 is not necessary as there are other alternatives. The mean and SD for the total attitudinal barriers score was 9.2 (SD ±2.1; range 4 to 16) out of a possible score of 16. The median was 9.0 (IQR 8.0

to 10.0). The attitudinal barriers scores were categorized as a score of 9 to 16 or 4 to 8, based on the median split; as such, a total of 1238 (66.7%; 95% CI 64.5–68.8) were categorized as having a score of 9 to 16 and 618 (33.3%; 95% CI 31.2–35.5) had a score of 4 to 8.

Religious health fatalism

Figure 2 shows the proportion of responses to the RHFQ-HI items. The highest proportion of strongly agree/agree (57.6%; 95% CI 55.3–59.9) was reported for item ‘I can control a small health issue, but only God can control a big health issue’. The lowest proportion of strongly agree/agree (3.6%; 95% CI 2.8–4.6) was reported for the item ‘I don’t need to try to improve my health because I know it is up to God’. The mean and SD for the total RHFQ-HI score was 9.7 (SD ±2.6; range 4 to 20) out of a possible score of 20. The median was 10.0 (IQR 8.0 to 11.0). The RHFQ-HI scores were categorized as a score of 10 to 20 or 4 to 9, based on the median split; as such, a total of 1004 (54.1%; 95% CI 51.8–56.4) were categorized as having a score of 10 to 20 and 852 (45.9%; 95% CI 43.6–48.2) had a score of 4 to 9.

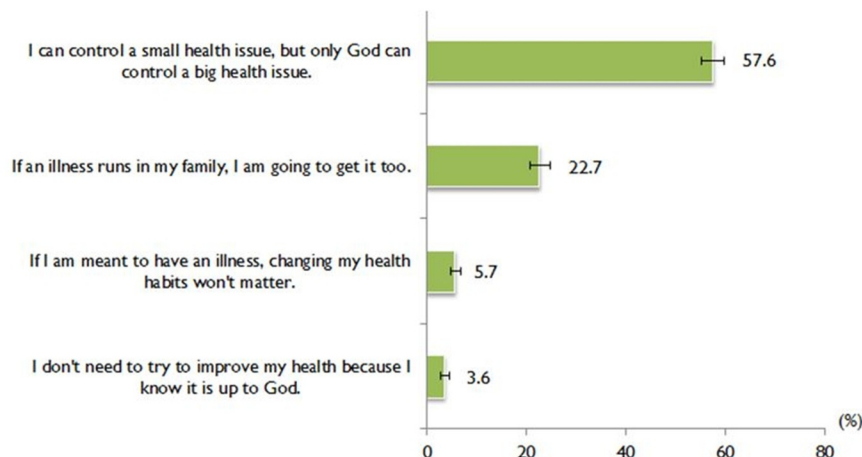


Figure 2. Proportion strongly agree/agree Religious Health Fatalism Questionnaire (RHFQ-HI) items (N = 1856).

Intention to receive a COVID-19 vaccine

On the whole, a total of 1,747 (94.1%) participants responded *yes* to COVID-19 vaccine intent, while only 109 (5.8%) responded *no*. By a more specific breakdown, the majority responded *definitely yes* (57.3%; 95% CI 55.0–59.6) followed by *probably yes* (42.7%; 95% CI 40.4–45.0%). Only 1.9% (95% CI 1.4–2.7) responded *definitely no* and *probably no* (3.9%; 95% CI 3.1–4.9).

The third and fourth column of Table 2 shows the univariable and multivariate analyses of factors associated with the *definitely yes* response to intention to be vaccinated against COVID-19. By demographics, the multivariable analysis finding indicated that the 18–30 age group reported the highest likelihood of a definite intention to take the COVID-19 vaccine (OR = 1.50; 95% CI 1.03 to 2.20) than the age group above 50 years old. There is a gradual increase in COVID-19 vaccine intent with an increase in income. Participants of income MYR4001–8000 (OR = 1.90; 95% 1.33–2.72) and MYR8001 and above (OR = 1.68; 95% 1.14–2.45) reported significantly higher COVID-19 vaccine intent than those of income MYR2000 and below.

The attitudinal barriers score was found to significantly influence COVID-19 vaccination intent, whereby participants who have lower attitudinal barrier score reported higher COVID-19 vaccination intent (OR = 6.75; 95% 5.20–8.75). Support in immunization also significantly influenced COVID-19 vaccination intent. Participants who were pro-vaccine reported a higher likelihood of intention to be vaccinated against COVID-19 than participants who were vaccine-hesitant/anti-vaxxer (OR = 2.76; 95% 1.97–3.87). Of note, univariate analysis showed that of the total 12% (n = 222) participants that identified themselves as vaccine-hesitant or anti-vaxxer, only 26.6% (n = 59) reported a definite intent to receive the COVID-19 vaccine. Although religious health fatalism was not significantly associated with COVID-19 vaccination intent in the multivariate analysis, in the univariable analysis, a significantly higher proportion of participants with a score of 4–9 (61.9%) in the RHFQ-HI reported intent to receive COVID-19 vaccine than those of score 10–20 (53.5%), $p < .001$.

Discussion

The acceptance of the vaccine among Muslims warrants urgent research due to long-standing issues surrounding vaccine hesitancy. The Islamic Law states that when faced with emergency circumstances that ‘threaten[s] the life of a nation’ the use of non-halal-certified substances is allowed.²⁴ Of positive note, the vast majority of our study was able to accept a non-halal-certified vaccine when there is a necessity—such as in a desperate and emergency situation and there is no alternative medicine. The process of manufacturing a halal COVID-19 vaccine is likely to take a longer time to materialize. The process and cost of a halal-certified vaccine remain the greatest challenge in its production. In the meantime, religious authority in Muslim countries needs to enlighten the public on the importance of accepting a COVID-19 vaccine, although it may not be halal-certified at the point of its availability. The public may be worried about whether the new COVID-19 vaccine is permissible on religious grounds. It has

been suggested that religious leaders should emphasize the fact that not all vaccine contains non-halal materials and if there is any, the amount of the material is insignificant, or almost negligible.⁴ In addition, the WHO for the Eastern Mediterranean confirmed that the porcine sources used in many vaccines have undergone characteristic changes from impure substances into pure substances (*istihalah*) that are permissible for use.¹⁵ Hence, the Ulama (Muslim religious leaders) and the Fatwa Council members of the country must take a unified stance and inform the public about the Islamic view on the permissibility of COVID-19 so that they could help to alleviate public concern about the vaccine being permissible for Muslims. In consideration of the high global Muslim population, there is potentially a massive global demand for halal COVID-19 vaccines in the near future. The findings of this study highlight the importance of research and production of halal COVID-19 vaccine to serve the needs of the huge global Muslim population to effectively curb the pandemic.

As shown in the results, slightly over one-third expressed reluctance to accept a new vaccine for the new coronavirus based on the safety and effectiveness of a newly developed vaccine. This indicates that people warrant assurance or evidence of the vaccine to be safe and effective before administration. This finding evidences the importance of providing information on the safety and effectiveness of the new COVID-19 vaccine to the public to enhance their acceptance of the new vaccine. This is in line with the WHO recommendations that the development of a COVID-19 vaccine, although it should be accelerated, should not be deployed without sufficient confidence in its safety and efficacy.²⁵

A preference for COVID-19 vaccination alternatives to curb the COVID-19 was evident in this study. A considerably small proportion of the study participants noted that the COVID-19 vaccine is not necessary as there are other alternatives. The alternatives could be pharmacology treatment, other alternative treatments or non-pharmalogical prevention. Unfortunately, the details of the types of COVID-19 vaccination alternatives were not probed in this online survey. Further research is required to understand the preference of COVID-19 vaccination alternatives. In Malaysia, vaccine hesitancy in the national immunization programmes based on reasons other than religious concerns of the halal issue of the vaccine was common. These include beliefs in alternative therapies or treatment, namely traditional medicine and use of food supplement.⁹

The COVID-19 vaccine acceptance among the Muslim population in this study was high, with 57% reporting a definite intent. By demographic, multivariate analysis found that a higher definite intent to be vaccinated against COVID-19 was associated with younger age and higher income. Systematic reviews similarly found younger age and socio-economic status as important determinants for the uptake of seasonal influenza vaccination.^{26–28} Immunization attitudes, specifically lower attitudinal barriers were associated with the highest odds ratio for a definite vaccination intent found in this study, implying its strong influence on COVID-19 vaccination intent. Similarly, previous reviews also reported attitudinal barriers inversely influence intention to get vaccinated against influenza.^{28,29} Therefore, it is recommended that intervention for attitude change toward people who are skeptical about COVID-19 vaccination is of utmost importance.

Support in immunization was found as the second most important predictor of COVID-19 vaccine intent. Pro-vaccine people expressed a higher likelihood of having a definite intent to receive the COVID-19 vaccine. This study provides valuable information that shows that despite COVID-19 being highly infectious and a life-threatening illness, the vaccine-hesitant and anti-vaxxer were still skeptical about a COVID-19 vaccine.

In the current study, COVID-19 vaccine acceptance was positively associated with younger age, contrary to studies reporting higher acceptance among older age people in a global survey.³⁰ The reason why the younger age group had higher COVID-19 vaccination acceptance requires further investigation. Similar to other studies,³¹ this study found less vaccine acceptance among the participants with low income. The finding is of concern because low-income groups are at higher risk of contracting COVID-19 due to reasons such as overcrowded living conditions and more likely to commute using public transportation which limits their social distancing ability.^{32,33} Therefore, it is important to enhance COVID-19 vaccination willingness in individuals of lower socio-economic classes.

It is also important to note that in this study, although religious health fatalism was not significantly associated with COVID-19 vaccination intent in the multivariate analysis, in the univariable analysis, higher religious health fatalism belief was significantly associated with lower intent to COVID-19 vaccination. This implies that higher religious health fatalism beliefs do have some degree of influence in COVID-19 vaccination. Of note, this study is also the first to reveal that the belief that death is inevitable influences the COVID-19 vaccination intent. Thus, our findings provide the basis for the need for targeted behavioral interventions to decrease perceptions of fatalism among the Muslims. Malaysia is a moderate Muslim country, and to the best of our knowledge, this study is also the first study that examines the helpless inevitability construct of religious health fatalism among Muslims. The median score of 10 out of the highest score of 20, coupled with a total of slightly over half of the participants reporting the higher score of 10–20, implies that the study participants have a moderate level of religious health fatalism measured by the Helpless Inevitability subscale of the Religious Health Fatalism Questionnaire.⁵ The RHFQ-HI score in this study was similar to that reported among African-American.⁷

Some limitations have to be taken into account when the results of this study are interpreted. First, our study adopted a cross-sectional design, so we were able to identify associations between exposure and outcomes but could not infer cause and effect. Second, the non-probability sampling technique using an online web-based questionnaire via a social media platform may lead to selection bias, as reflected in the large sample of females and participants from professional and managerial groups. Nonetheless, the study received responses from all the states and federal territories of Malaysia, although a slightly higher number of responses were from the southern region. Of note, an important limitation associated with the unequal distribution of the number of responses may result in low statistical power in some subgroups. The bivariate screening methods were insufficient to control confounding and could exclude important variables from the multivariable analyses,³⁴ hence resulting in uncontrolled confounding and biased results.³⁵ Another limitation is the low Cronbach's alpha coefficient for the

attitudinal barriers (.606) and the RHFQ-HI (.493) found in this study. Although a Cronbach's alpha coefficient greater than .70 means an acceptable degree of consistency in exploratory studies its acceptable value is reduced to .50.^{36–39} The reason for the low Cronbach's alpha coefficient for the RHFQ-HI in this study is unclear; in contrast, the RHFQ-HI was found to have a Cronbach alpha reliability coefficient of .89 in another study.⁷ Another disadvantage of online survey research includes uncertainty over the validity of respondents' inclusion criteria, for instance, whether the responses are genuinely from Muslims, as the online survey was distributed to an unknown audience in the social media. Additionally, self-assessment of religiosity in this study based on a four-point Likert scale may also lead to potential bias. Despite these limitations, we believe our findings provide guidance for public health intervention to enhance COVID-19 vaccine uptake among Muslims in Malaysia as well as globally. Lastly, it is important to note that this study was conducted during the early phase of the COVID-19 pandemic and before the COVID-19 vaccines are available. To date, although COVID-19 vaccination is not compulsory in Malaysia, unvaccinated individuals will lose out on many privileges, including praying at mosques, dining out, and going for Umrah in Saudi Arabia.⁴⁰ As of January 2022, 78.6% of the population in Malaysia were fully vaccinated against COVID-19.⁴¹ The vaccination rate of the adult population of Malaysia is getting closer to 100%, with an approximately 98% having completed their COVID-19 vaccination.⁴²

Conclusions

The introduction of the new coronavirus is anticipated to be accompanied by a variety of challenges, particularly for the Muslim population. Acceptance of the COVID-19 vaccine is high among the Muslims in Malaysia. Important predictors of a definite intention to take the COVID-19 vaccine include positive COVID-19 immunization attitudes and support in immunization. Intervention for attitude change toward people who are skeptical about COVID-19 vaccination to enhance attitudes is needed. Despite COVID-19 being highly infectious and a life-threatening illness, the vaccine-hesitant and anti-vaxxers in this study were still skeptical about the COVID-19 vaccination. An in-depth understanding of how the anti-vaccine Muslim community is responding to the COVID-19 vaccine is important to provide insights for behavioral change intervention. The study also revealed that health fatalistic beliefs also have some degree of influence on COVID-19 vaccination intent, thus warranting the support of religious leaders. Understanding the Islamic perspective on COVID-19 vaccination provides important insights into future immunization policies into increasing vaccination coverage.

Author contributions

L. P.W., Y.L. and Z.H. planned the study. L.P.W., H.A., H.Y.L, S.A.B., I. C., and M.M.A.A.M.H obtained the data. L.P.W. and H.A. performed the data analysis and data summarization. L.P.W. drafted the manuscript. All authors critically reviewed the manuscript; gave final approval of the version to be published; agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure statement

The authors declare no conflict of interests.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to ethical restrictions.

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