Knowledge, Motivators, Concerns and Brand Preferences regarding COVID-19 Vaccination among Patients and Caregivers in Sibu Hospital

Sie Chai Lau[1*], Jude Yip Kiong Siong[1], Stephanie Kee Yiin Ung[1], Joreen Shou Bing Lee[1], Siu Zhi Siew[1]

[1]*Department of Pharmacy, Sibu Hospital*

Correspondence to: Sie Chai Lau (siechai@moh.gov.my)

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ABSTRACT

Introduction:

The public's knowledge, motivators, concerns, and brand preferences regarding COVID-19 vaccination significantly influence vaccine acceptance. This study aimed to assess these factors among patients and caregivers at Sibu Hospital.

Methods:

A cross-sectional study was conducted from December 2021 to January 2022. The questionnaire used in the study was adapted from existing literature, with reliability coefficients ranging from 0.779 to 0.856 for knowledge, motivators, and concerns. It was distributed to patients and caregivers visiting Sibu Hospital and self-administered through convenience sampling. Data were analyzed using descriptive analysis methods.

Results:

In the study, 409 respondents participated, with a significant majority falling within the 21-30 age range (41.6%). The majority of respondents were Chinese (38.6%) and employed (55.7%). A notable 92.4% of respondents were aware that adults over 18 were eligible for the COVID-19 vaccine. Social media emerged as the most influential source of information on COVID-19 vaccination (45.2%), and 88.3% of respondents were motivated to get vaccinated because it was available free of charge. Concerns about the COVID-19 vaccine were expressed by 62.1% of respondents, primarily due to its rapid development and approval. Brand preference varied, with Cominarty being the most preferred (53.3%) and CoronaVac following closely at 40.1%. Notably, CoronaVac was preferred more among the Chinese respondents, while Cominarty was favored by others.

Conclusion:

Respondents demonstrated a good understanding of the eligibility criteria for COVID-19 vaccines. The availability of free vaccination strongly motivated them to get vaccinated, despite some expressing concerns about the safety as the vaccines were developed and approved rapidly. Social media emerged as a powerful tool for disseminating accurate information about vaccination, given its perceived influence among respondents.

Keywords:

COVID-19, vaccination, patients, caregivers, Pharmacy

INTRODUCTION

The COVID-19 outbreak first surfaced in China at the end of 2019, subsequently spreading worldwide, including to Malaysia.[1] The Malaysian government responded with various measures to combat its spread, such as implementing lockdowns and launching the National COVID-19 Immunization Program (PICK). PICK aimed to immunize the Malaysian population against COVID-19. To ensure accessibility, the government offered free vaccinations to the public registered through the mySejahtera application, regardless of citizenship status.[2] By February 2023, Malaysia had approved several vaccines, including Spikevax by Moderna, Comirnaty by Pfizer, Convidecia by CanSino, Vaxzevria by AstraZeneca, CoronaVac by Sinovac, Jcovden by Janssen (Johnson & Johnson), Covaxin by Bharat Biotech, and Cavilo by Sinopharm.[3]

Public acceptance of COVID-19 vaccines is pivotal in containing infections. Several studies highlight a strong willingness among Malaysians to receive COVID-19 vaccines, with acceptance rates of 83.3%, 64.5%, and a striking 93.2% among adults over 18 years old.[4-6] Additionally, the Malaysian Ministry of Health reported a 67% acceptance rate, with the majority expressing confidence in the vaccines' safety (95.7%), effectiveness (89.6%), and authenticity of ingredients (67.4%).[5]

Factors influencing vaccine acceptance encompass a wide range of elements, including healthcare professional recommendations, socio-demographic characteristics, ease of vaccination access, and associated costs.[4] Interestingly, a recent study in Malaysia have indicated that younger individuals, those with higher education levels, and females indicated higher COVID-19 vaccine acceptance.[5] These findings underscore the importance of tailored communication strategies and targeted interventions to enhance vaccination uptake across diverse demographic groups.

However, vaccine hesitancy posed as a significant challenge for successful vaccination programs.[4] Defined as "a delay in acceptance or indecision about vaccination despite the availability of services", vaccine hesitancy is influenced by concerns over side effects, safety, ingredients, and efficacy of COVID-19 vaccines. [7,8] Misinformation spread through media channels has exacerbated these concerns, perpetuating doubts about vaccine development, technology, and side effects.[9]

Recent data as of November 15, 2022, revealed that 86% of Sarawak's population had received at least two doses of COVID-19 vaccines, though only 56.1% had received three doses compared to 70.5% in Selangor by November 2022.[10,11] The emergence of variants of interest and concern since late 2020 has further underscored the need for ongoing vaccination efforts, including booster doses.[12] Consequently, understanding public knowledge, motivators, concerns, and brand preferences related to COVID-19 vaccination is essential.

To address vaccine hesitancy effectively, this study aimed to: (i) assess public knowledge and eligibility regarding COVID-19 vaccines, (ii) explore motivators, concerns, and information sources influencing vaccination uptake, and (iii) investigate preferences for specific vaccine brands. The findings will provide policymakers with baseline insights to implement targeted interventions aimed at improving public understanding and dispelling misconceptions about COVID-19 vaccines.

METHODS

Study Design

This cross-sectional study was conducted from December 2021 to January 2022 among patients and caregivers visiting Sibu Hospital. The sample size was determined using the Krejcie and Morgan table.[13] Based on the average number of new prescriptions filled at the hospital pharmacy (8,215 from January to May 2021), a minimum sample size of 368 was calculated to adequately represent the population).

To account for a projected 25% dropout rate, the sample size was increased and rounded up to 500 respondents. The decision to use data from January to May 2021 for estimating the sample size was influenced by the impact of COVID-19 on earlier data in 2020, which did not accurately reflect the hospital's patient population at that time

This study included patients and caregivers aged 18 years and above, who visited Sibu Hospital during the data collection period and were able to read and comprehend Malay, English, or Mandarin. Exclusion criteria comprised individuals who were illiterate and healthcare-related workers.

Questionnaire

The questionnaire used in this study was self-administered and available in both hardcopy and online via Google Forms. Respondents were given the option to choose their preferred method for completing the questionnaire.

It consisted of three sections totaling 18 items: Section A focused on sociodemographic profiles with 6 items. Section B covered knowledge, motivators, and concerns related to COVID-19 vaccines, comprising 10 items, which are (i) Items 1-4 assessed knowledge about COVID-19 vaccines and information sources influencing vaccination decisions, (ii) Items 5-9 explored motivators influencing vaccine acceptance, and (iii) Item 10 specifically addressed respondents' concerns regarding COVID-19 vaccination. Lastly, Section C included 2 items to investigate preferences for specific brands of COVID-19 vaccines and the reasons behind these preferences.

Sections A and C were developed through discussions among investigators, including two senior pharmacists from clinical fields and three junior pharmacists. Section B was adapted from a prior study with approval obtained from the original author via email. The questionnaire's reliability was assessed with Cronbach's alpha coefficients of 0.856 for knowledge and 0.779 for concerns.[14]

Initially developed in English, the questionnaire was translated into Malay and Chinese to accommodate self-administration. Forward and backward translations were performed by five pharmacists to ensure accuracy and equivalence across languages. Discrepancies between versions were resolved through investigator discussions following pretesting on three healthcare providers and three laypersons. Feedback indicated that the questionnaire was easy to understand and could be completed within 10 to 15 minutes.

Based on pretesting feedback, minor adjustments were made. For example, item 2 was refined to differentiate between children under 12 years old and adolescents aged 12 to 18 years old. Additionally, "pregnant ladies and lactating mothers" were separated into distinct categories: "pregnant ladies" and "lactating mothers." These adjustments aimed to clarify eligibility criteria for COVID-19 vaccination among specific demographics according to Malaysian approval guidelines.

Data Collection

Convenience sampling was employed to recruit respondents due to time and manpower limitations. Patients or caregivers waiting for medications in various hospital areas during office hours, such as Outpatient Pharmacy, Inpatient Pharmacy, Drive-Through Pharmacy, and wards were approached. They were provided with a participant information sheet and a consent form before being offered the questionnaire. Caregivers, defined as those providing care and support to patients (e.g., family members or friends accompanying patients), were included in the study if they were at least 18 years old and could read and understand Malay, English, or Mandarin. Healthcare-related workers were excluded to minimize potential bias due to their potentially higher knowledge levels.

Respondents were provided with informed consent forms before proceeding with the questionnaire. Anonymity and confidentiality were maintained by not collecting any identifying information in the questionnaire. To prevent duplicate responses, respondents were asked during recruitment if they had previously participated in the study.

The questionnaire, available in both hardcopy and online, took approximately 20 minutes to complete. Each hardcopy questionnaire was reviewed upon collection, while online responses required all items to be completed before submission.

Respondents could submit responses at their convenience, and late submissions were accepted.

Statistical Analysis

All collected data were entered into a Microsoft Excel spreadsheet and subsequently analyzed using Statistical Package for the Social Sciences (SPSS) software version 22. The analysis involved simple descriptive statistics to summarize the findings across various aspects which included demographic characteristics, knowledge regarding COVID-19 vaccine, sources of information influencing perception, barriers and drivers to COVID-19 vaccine and preference over different vaccine brands and the reasons.

RESULTS

Part A: Demographic data

A total of 500 patients and caregivers were initially approached at Sibu Hospital during the data collection period. From this group, six respondents were excluded during screening because they were underage or illiterate, while another 13 declined to participate and another 56 were excluded as they were healthcare-related workers.

After screening, 425 participants remained eligible. However, 16 responses collected via hardcopy forms were incomplete and thus not included in the final analysis. Consequently, the final dataset included responses from 409 participants, resulting in an overall completion rate of 96.2%. (Figure 1)

The respondents' age distribution was skewed to the right, with a median age of 32 years old (IQR=16 years), ranging from 18 to 73 years old. The largest proportion of respondents (41.6%) fell within the age range of 21-30 years old. Ethnically, the majority of respondents identified as Chinese (38.6%) or Iban (36.9%). Regarding employment status, 55.7% of respondents were employed, and a significant majority (81.9%) had attained at least a secondary school education. In terms of vaccination status, the vast majority (98.1%) of respondents received at least two doses of a COVID-19 vaccine. The socio-demographic characteristics of the respondents are shown in Table 1.

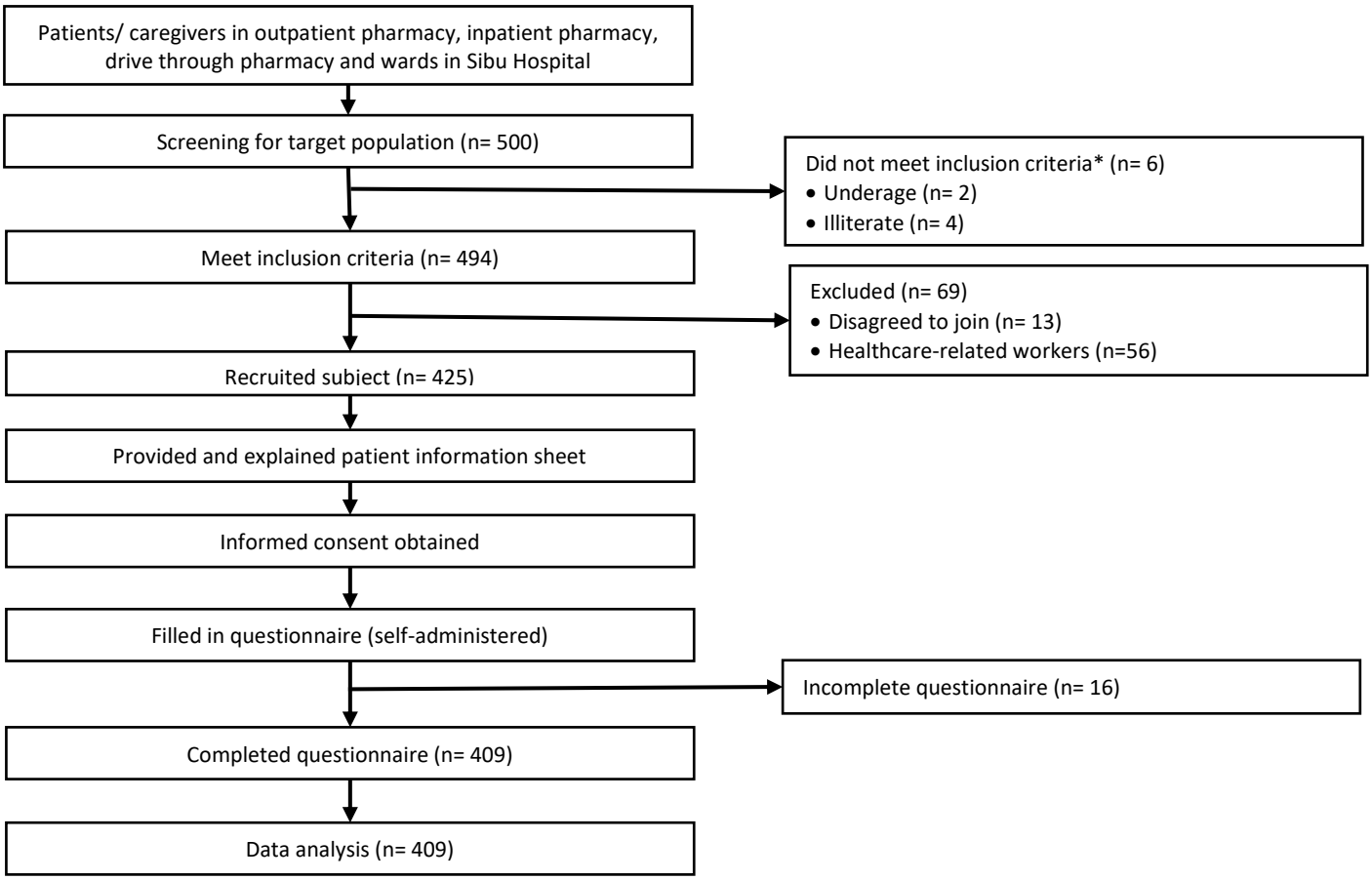

Figure 1. Study workflow

Table 1. Socio-demographic characteristics (n=409)

Characteristics	n (%)
Age (years)	
Less than 20 years	19 (4.6)
21-30 years	170 (41.6)
31-40 years	112 (27.4)
41-50 years	60 (14.7)
51-60 years	35 (8.6)
More than 60 years	13 (3.2)
Ethnicity	
Chinese	158 (38.6)
Iban	151 (36.9)
Malay	68 (16.6)
Others	32 (7.8)
Religion	
Christian	251 (61.4)
Islam	109 (26.7)
Buddhist	40 (9.8)
Others	9 (2.2)
Highest educational level	
No formal education	13 (3.2)
Primary school education	61 (14.9)
Secondary school and higher	335 (81.9)
Employment status	
Employed	228 (55.7)
Not employed	181 (44.3)
Vaccination Status	
Received first dose	3 (0.7)
Received first and second dose	148 (36.2)
Received third dose	253 (61.9)
Had not received any dose	5 (1.2)

Part B: Knowledge, source of information, motivators and concerns related to COVID-19 vaccines

Knowledge on the eligibility of COVID-19 vaccine

Respondents were queried about the eligibility criteria for receiving the COVID-19 vaccine. Among the statements assessed, "It is legally mandatory to take COVID-19 vaccine" received the lowest correct response rate, with only 20.3% of participants answering correctly. Conversely, a significant majority (92.4%) correctly identified that adults aged 18 years and above were eligible for COVID-19 vaccination (Figure 2).

Sources of information regarding COVID-19 vaccine

Respondents were also asked about the sources of information influencing their opinions on COVID-19 vaccination. Social media emerged as the most influential, impacting perceptions significantly at 45.2%, followed by healthcare providers (38.9%), government agencies (37.2%), news from TV or radio (35.9%), family and friends (34.7%) and. Other sources, including newspapers, healthcare-related websites, flyers, and medical journals (6.6%) (Figure 3).

Motivators to accept COVID-19 vaccine

The majority (88.3%) indicated they would receive COVID-19 vaccine because it is available free of cost, while 85.6% cited the high uptake of the vaccine by others as a motivating factor. In contrast, only 68.5% agreed that vaccination help in eradicating COVID-19 (Table 2).

Concerns on COVID-19 vaccine

More than half (62.1%) expressed concerns about the COVID-19 vaccine due to its rapid development and approval. Additionally, respondents cited concerns about potential immediate side effects (39.6%) and unforeseen future effects (38.6%) after vaccination (Table 3).

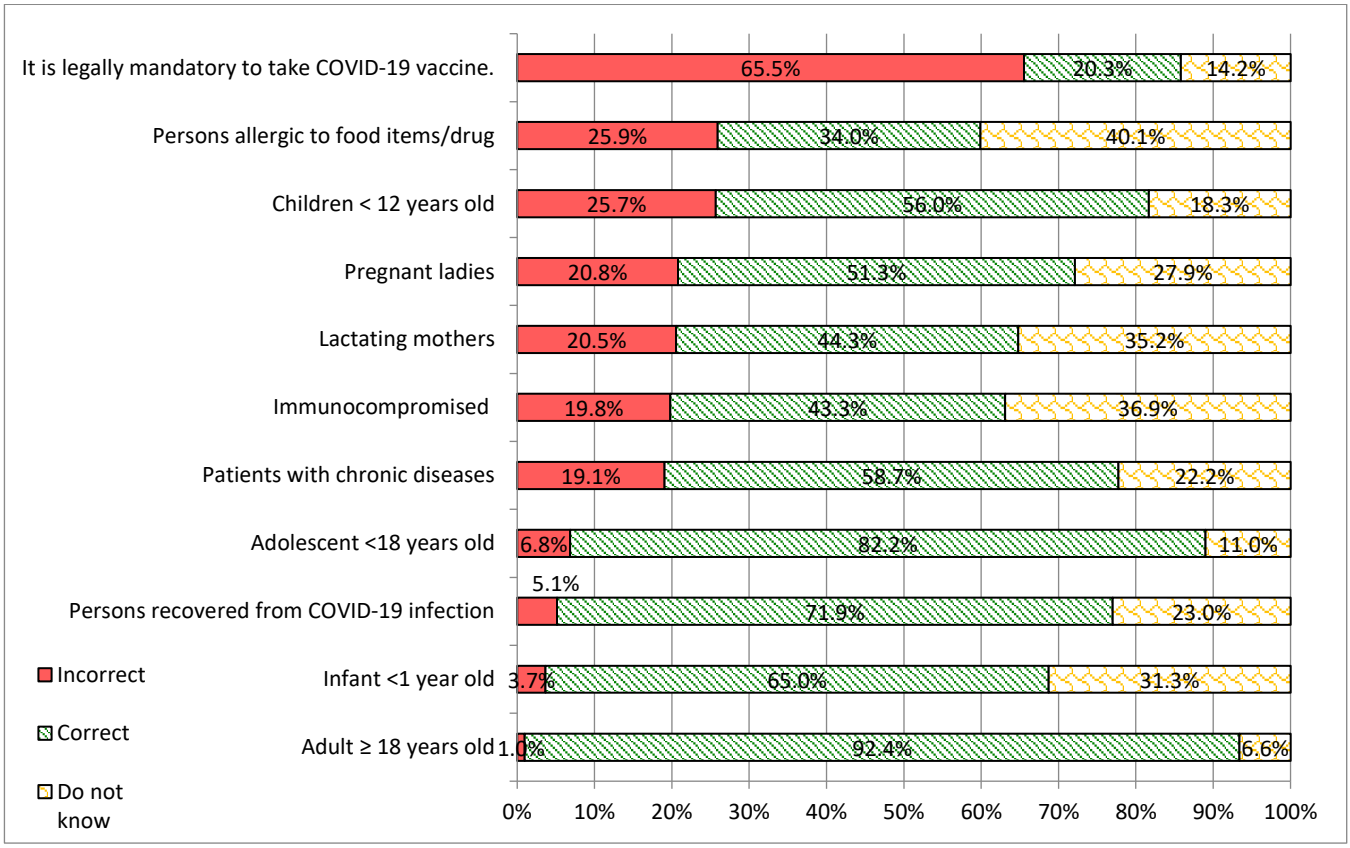

Figure 2. Knowledge on the eligibility of COVID-19 vaccine

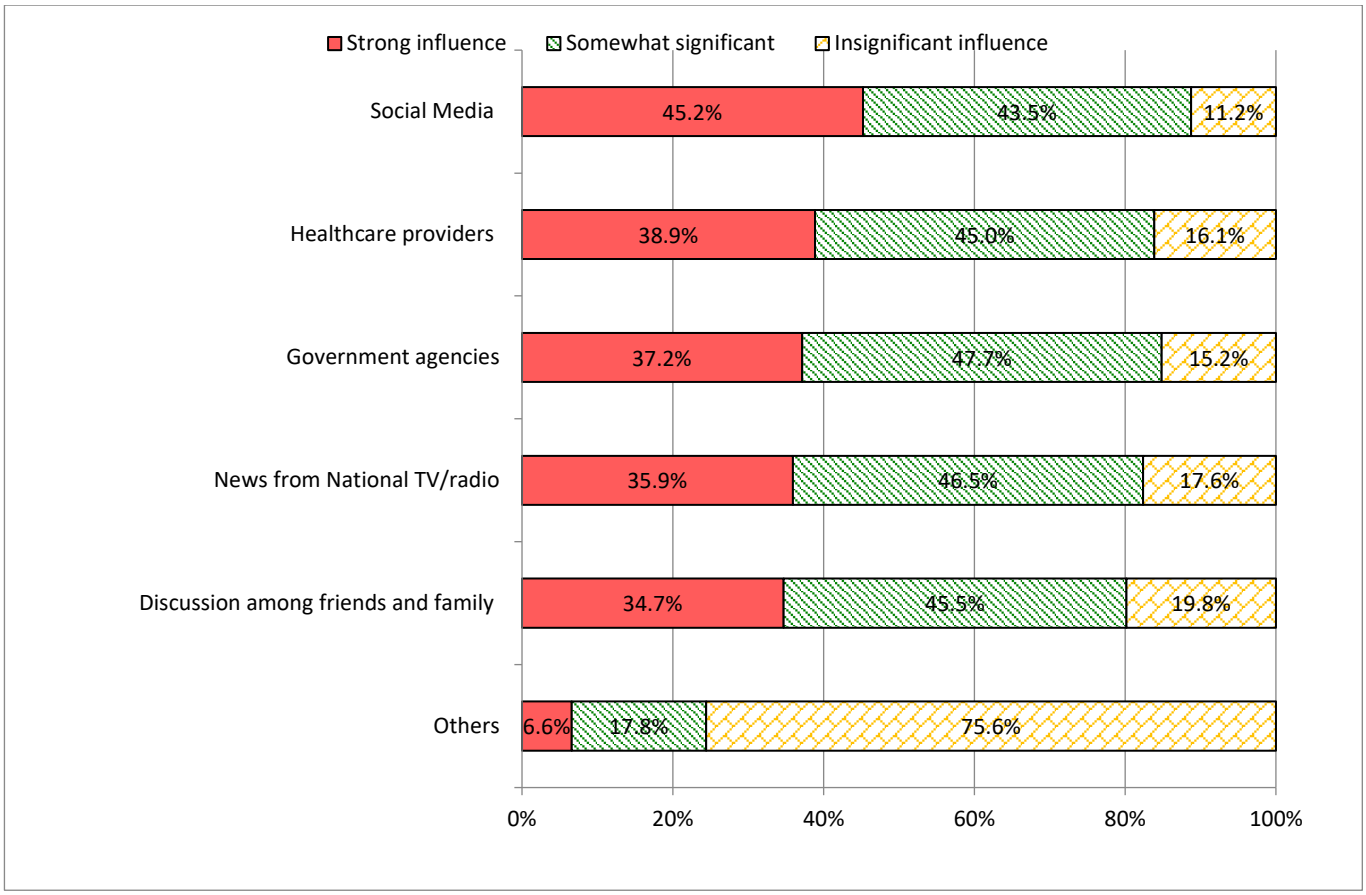

Figure 3. Sources of information regarding COVID-19 vaccine

Table 2. Motivators to accept COVID-19 vaccine (n=409)

I have / will receive COVID-19 vaccine because	Agree, n(%)	Neutral, n(%)	Disagree, n(%)
COVID-19 vaccine is available free of cost.	361 (88.3)	37 (9.0)	11 (2.7)
Many people are taking the COVID-19 vaccine	350 (85.6)	50 (12.2)	9 (2.2)
I believe that taking the COVID-19 vaccine is a societal responsibility.	342 (83.6)	59 (14.4)	8 (2.0)
I believe COVID-19 vaccine will be useful in protecting me from the COVID-19 infection	338 (82.6)	63 (15.4)	8 (2.0)
I think there is no harm in taking COVID-19 vaccine.	336 (82.2)	62 (15.2)	11 (2.7)
My role models/ political leaders/ senior doctors / scientists have taken COVID-19 vaccine.	325 (79.5)	72 (17.6)	12 (2.9)
My healthcare professional/ doctor has recommended me.	310 (75.8)	80 (19.6)	19 (4.6)
There is sufficient data regarding the vaccine's safety and efficacy released by the government.	312 (76.3)	76 (18.6)	21 (5.1)
I feel the benefits of taking the COVID-19 vaccine outweighs the risk involved.	285 (69.7)	88 (21.5)	38 (8.8)
I think it will help in eradicating COVID-19	280 (68.5)	95 (23.2)	34 (8.3)

Table 3. Motivators to accept COVID-19 vaccine (n=409)

I am concerned that	Agree, n(%)	Neutral, n(%)	Disagree, n(%)
COVID-19 vaccine was rapidly developed and approved.	254 (62.1)	121 (29.6)	34 (8.3)
I might have immediate side effects after taking COVID-19 vaccine.	162 (39.6)	138 (33.7)	109 (26.7)
I might have some unforeseen future effects of the COVID-19 vaccine.	158 (38.6)	161 (39.4)	90 (22)
COVID-19 vaccine might not be easily available to me.	141 (34.5)	117 (28.6)	151 (36.9)
COVID-19 vaccine may be faulty or fake.	117 (28.6)	130 (31.8)	162 (39.6)
COVID-19 vaccine is being promoted for commercial gains of pharmaceutical companies.	99 (24.2)	156 (38.1)	154 (37.7)

Part C: COVID-19 vaccine brand preferences and the reasons behind

Preferences on COVID-19 vaccine brands

Table 4 illustrates the preferences for various brands of COVID-19 vaccines among the respondents. Cominarty had the highest percentage at 53.3%, followed by Coronavac at 40.1%. Interestingly, the majority of Malay (63.2%), Iban (57.6%), and other ethnicities (62.5%) favor Cominarty, whereas a larger proportion of the Chinese population (48.7%) prefered Coronavac.

Reasons behind brand preferences of COVID-19 vaccine

The preferences for different brands of COVID-19 vaccines were influenced by several factors. The majority of respondents chose their preferred brands based on their belief in higher effectiveness (36.9%) and perceptions of fewer side effects (32.0%). Recommendations from friends and family played a role for 19.6% of respondents, while social media platforms like Facebook, Instagram, and WhatsApp influenced 7.1% of preferences. Other reasons accounted for 4.4% of brand preferences.

Table 4. Preferences for COVID-19 vaccine brands according to race

Brands of COVID-19 Vaccine	All, n (%) (n= 409)	Malay, n (%) (n= 68)	Chinese, n (%) (n= 158)	Iban, n (%) (n= 151)	Others, n (%) (n= 32)
Cominarty (Pfizer)	218 (53.3)	43 (63.2)	68 (43.0)	87 (57.6)	20 (62.5)
CoronaVac (Sinovac)	164 (40.1)	22 (32.4)	77 (48.7)	54 (35.8)	11 (34.4)
Vaxzevria (AstraZeneca)	19 (4.6)	3 (4.4)	10 (6.3)	5 (3.3)	1 (3.1)
Jcovden (Janssen)	3 (0.7)	0 (0.0)	1 (0.6)	2 (1.3)	0 (0.0)
Convidecia (CanSino)	3 (0.7)	0 (0.0)	0 (0.0)	3 (2.0)	0 (0.0)
Covilo (Sinopharm)	2 (0.5)	0 (0.0)	2 (1.3)	0 (0.0)	0 (0.0)

DISCUSSION

Knowledge on COVID-19 vaccine

Our study found that respondents generally exhibited moderate knowledge of COVID-19 vaccines, which marks an improvement from a previous study where 62% of respondents had poor knowledge about COVID-19 vaccines.[5] This difference can be attributed to the varying time frames of data collection; our study was conducted at the end of 2021, whereas the previous study took place in 2020, when COVID-19 vaccines were newly introduced. Additionally, selection bias may have also played a role in the variation, as our study specifically targeted patients and caregivers visiting hospital pharmacies rather than the general public.

The majority of respondents mistakenly believed that COVID-19 vaccination was legally mandatory. In reality, while Malaysia did not issue mandates, strict regulations were enforced for unvaccinated individuals, effectively creating a de-facto vaccine mandate.[15,16]

Approximately half of the respondents correctly understood that pregnant and lactating women are eligible for vaccination. Concerns were raised about the lack of safety and efficacy data in these populations; however, studies have not shown safety issues with COVID-19 vaccination in pregnant women and have demonstrated its efficacy in reducing disease severity and other health impacts.[17-19] Some reports even indicated the presence of antibodies in the breast milk of vaccinated lactating mothers, potentially offering protection to their infants, though further research is needed to determine the extent of this protection.[20-22]

Approximately half of the respondents answered most questions correctly, highlighting the need for the government to enhance public knowledge and attitudes towards COVID-19. Strategies could include organizing educational seminars, producing informative videos, and broadcasting awareness campaigns on television and radio to reach a broader segment of Malaysian society.

Sources of information regarding COVID-19 vaccine

Sources of information played a vital role in sharing information, and information itself had an impact on facilitating vaccination uptake. In our study, social media influenced the public's opinions most significantly, accounting for 45.2%. Our findings were supported by a study conducted by Al-Marshoudi et al., which also showed that social media was the main source of information (67%).[23] The government of Malaysia utilized social media effectively, such as through the 'Kementerian Kesihatan Malaysia' Facebook page and YouTube channel, where they posted numerous informative posters, infographics, and videos to disseminate accurate knowledge about COVID-19 and promote vaccination among citizens.

Additionally, MySejahtera was developed by the Malaysian government to help manage COVID-19, serving as a platform to distribute posters and infographics from the Crisis Preparedness and Response Centre (CPRC) KKM.

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However, social media was a double-edged sword as it could also be used to spread misinformation. The rapid spread of misinformation caused uncertainty worldwide, leading the public to be affected by rumors or fake news. Hence, it was important to emphasize to the public that rumors should be checked and verified from reliable sources, such as the official 'Kementerian Kesihatan Malaysia' social media accountsAlthough the government monitored and regulated online content on social media, these efforts could still have been further strengthened to regulate misinformation, rumors, or fake news. Correcting false statements and misleading information online through public health experts and healthcare professionals aided in curbing and clarifying fake news. Social media companies should have also implemented and enforced rules and regulations to control the presence of misinformation on their platforms. Besides, the public should have also been actively inculcated with awareness and knowledge of how to filter information, for example, checking if the information was published via reliable resources, the credibility of the sources and platforms, and recognizing if it was evidence-based information. These efforts will be very beneficial in promoting vaccine acceptance.

Motivators and concerns regarding COVID-19 vaccine

In this study, our results indicated that the acceptance rate of COVID-19 vaccines was quite high. This finding was consistent with a study conducted by Woon et al. (Reference 9), where 93.2% of Malaysian adults over 18 years old indicated willingness to accept the COVID-19 vaccine, with only a 6.8% refusal rate.

Several factors and concerns regarding the COVID-19 vaccine directly influenced its acceptance. A significant majority of respondents agreed to receive the COVID-19 vaccine because it was available free of charge, which the Malaysian government had been providing throughout.

Another motivating factor for respondents was the belief that the COVID-19 vaccine was safe and offered protective effects. This belief was supported by a study involving 1396 respondents who had received the COVID-19 vaccine, where 86% cited the vaccine's role in reducing the risk of illness.[24] Similarly, a study from Latvia showed that 88.26% of respondents received the vaccine due to their belief in its effectiveness.[25] Indeed, vaccines such as Comirnaty have demonstrated effectiveness in preventing COVID-19 infections, ICU admissions, COVID-19-related deaths, and severe or critical disease in infected individuals.[26] Earlier studies among the Malaysian population also indicated that COVID-19 vaccines were 88% effective against COVID-19 infection in fully vaccinated individuals .[27]

However, concerns about the safety of COVID-19 vaccines and public trust issues posed obstacles to vaccine acceptance. Regarding safety concerns, a majority of respondents expressed worries due to the rapid development of the COVID-19 vaccine (61.3%) and concerns about immediate serious side effects (40.6%). A qualitative study examining anti-vaccine sentiments shared on social media highlighted that 26.8% of such sentiments (74 out of 276 anti-vaccine comments) were on long-term side effects and vaccine safety concerns.[28] Addressing vaccine hesitancy and anti-vaccine sentiments is crucial, as these factors can significantly hinder vaccine acceptance. Therefore, educational materials addressing these concerns with evidence-based information, including common adverse effects like fatigue, headache, body pain, and muscle pain associated with COVID-19 vaccines should be disseminated.[29] Social media, recognized as a highly influential information source that does not require close contact, can play a pivotal role in distributing such information.

Efforts to mitigate hesitation and build trust are essential to achieving higher vaccine acceptance rates and fostering positive intentions among the public. Enhancing health literacy through social and educational frameworks is crucial to preparing individuals to respond responsibly during pandemics and ensuring successful vaccination campaigns among the general population.[23]

COVID-19 vaccine brand preferences

The three predominant COVID-19 vaccines used in Malaysia were Cominarty, CoronaVac, and Vaxzevria. In the National COVID-19 Immunisation Programme (PICK), homologous vaccines were administered for both doses in the primary vaccination series for two-dose regimens.

As of December 2022, the National Pharmaceutical Regulatory Agency received 20,131 reports of adverse effects associated with the Comirnaty vaccine, equivalent to 449 reports per million doses (0.045%). The majority (94.2%) of these reports described non-serious, temporary side effects. Serious adverse events following immunization (AEFI) accounted for only 5.8% (1,162 reports), indicating potential health risks such as hospitalization, significant loss of capacity, or suspected deaths.[30]

Despite advanced procurement agreements, Malaysia received the majority of its Comirnaty supply in the late third quarter of 2021.[27] Consequently, CoronaVac saw more extensive use, accounting for half of all completed vaccinations. However, Cominarty remained more preferred due to its presumed effectiveness and efficacy, as indicated by the results.

Strengths, limitations and recommendations

This study has several strengths. Firstly, it provides foundational insights into the knowledge, motivators, concerns, and brand preferences related to COVID-19 vaccines among patients and caregivers. Such insights can inform the development of strategic vaccination plans by the government and help assess public awareness and knowledge regarding COVID-19 vaccines.

However, one of the study's limitations was the use of convenience sampling, which may not fully represent the target population. Specifically, the age distribution of our sample differed significantly from the general population of Sibu; for instance, the estimated population aged 20-29 in Sibu is approximately 25%, whereas our sample comprised 42% in that age group (170 out of 409 respondents).[31] Moreover, sampling exclusively from hospitals during office hours could introduce selection bias into the results, limiting the generalizability of our findings to the entire population of Sibu.

Additionally, the questionnaire had several limitations. It did not distinguish between secondary and tertiary education levels and did not include options for respondents to indicate their occupation. Furthermore, key demographic information such as gender, family income, and whether respondents were patients or caregivers was not collected. Although our study identified social media as the most influential source of information on COVID-19 vaccination, we did not gather specific details about the types of social media platforms used.

Addressing these limitations in future research could enhance the accuracy and applicability of findings related to COVID-19 vaccination perceptions and behaviors among diverse population groups.

CONCLUSION

This study offered foundational insights into the knowledge, motivators, concerns, and brand preferences concerning COVID-19 vaccines among patients and caregivers. Respondents demonstrated moderate knowledge regarding the eligibility criteria for COVID-19 vaccines. The availability of free vaccinations motivated many respondents to receive the vaccine, although concerns about the safety of rapidly developed COVID-19 vaccines were prevalent. Nonetheless, social media emerged as a powerful tool for disseminating accurate information, perceived by respondents as the most influential source of information on COVID-19 vaccines.

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CONFLICT OF INTEREST

The authors declare no conflict of interests.

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ETHICAL APPROVAL

This research project was registered in the National Medical Research Registry (NMRR ID-21-02086-UTY, dated 11 Nov 2021) and approved by the Medical Research and Ethics Committee, Ministry of Health Malaysia.

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