ORIGINAL ARTICLE

Assessment of Allergic Reaction of Covid-19 Vaccination among Malaysian Adults: A Cross-sectional Study

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ABSTRACT

Introduction: The AstraZeneca, Pfizer-BioNTech, and Sinovac-CoronaVac vaccines presented side-effects in their clinical trials thus, this study aims to assess the allergic reaction post-Covid-19 vaccination among Malaysian adults. **Materials and methods:** A cross-sectional study was performed using simple random sampling via social media platforms from March 2022 to June 2022. The study included an online questionnaire regarding sociodemographic, vaccine and allergy reactions. The inclusion criteria were Malaysian adults aged above 18 years old. Pregnant women, lactating women and individuals with comorbidities were included. The exclusion criteria were children aged below 18 years old and non-Malaysians. Estimated sample size using Cochran formula is 385 respondents (95% confidence interval, 5% margin error and 50% assumption of population proportion). **Results:** The response rate was 81% (315 respondents) with no previous history of Covid-19 infection and based on their first vaccination. Most of the respondents' age was between 21 to 30 and female (76%). Most respondents received Pfizer-BioNTech (48.9%), followed by Sinovac-CoronaVac (27.4%), and AstraZeneca (23.6%). Few respondents (7.59%) who received mRNA-based vaccines had mild allergic reactions, followed by the viral vector, and inactivated virus vaccines. Overall, 14.5% of respondents had mild allergic reactions characterized by superficial, and respiratory symptoms, while 0.28% experienced severe symptoms. Few respondents experienced allergic reactions which were similar to those reported in clinical trials. **Conclusion:** The most common allergic reaction was shortness of breath and wheezing. There is no significant association between type of vaccine and allergy ($p > 0.05$), further research is still needed to investigate long-term effects of Covid-19 vaccination.
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INTRODUCTION

Coronavirus Disease 2019, also known as Covid-19, is a contagious disease involving a new strain of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). This novel virus attacks the human respiratory system rapidly and is highly transmissible among humans (1). The origin of Covid-19 was linked to a city in Wuhan, China and spread through human-human transmission (1). On the 11th of March 2020, the World Health Organization proclaimed Covid-19 as a pandemic following the report in 54 countries worldwide (2). In order to curb the spread of the virus, the US Food and Drug Administration (FDA) released an emergency authorization of two types of Covid-19 vaccines in mid-December 2020: Pfizer-BioNTech and Moderna (3). These two vaccines were the fastest to be developed (4). Given the rapid development of these vaccines, people raised concerns about the potential adverse effects of taking the Covid-19 vaccination (5).

Allergic reaction due to Covid-19 vaccination has been reported by the Center for Disease Control and Prevention (CDC) and Food and Drug Administration (FDA) in the United States due to the vaccine ingredients, especially in mRNA vaccines (6). Despite the low incidence of severe post-vaccination allergic reactions, such as anaphylaxis, the few reported cases have been severe and fatal (6). The vaccination programme for Covid-19 in Malaysia was initiated on February 24, 2021. The Malaysian government described the immunization programme as a step towards achieving herd immunity across the population (7). Meanwhile, the booster

dose programme or PICK-B (Program Imunisasi Covid Kebangsaan-Booster) in Malaysia was implemented on the 13th of October 2021. As of December 2022, approximately 23 million people in Malaysia are fully vaccinated (71.87%).

Essentially, Covid-19 vaccines have been manufactured by several countries, including the United Kingdom, the United States, and China. The vaccines produced by these countries are useful for global usage, including Malaysia (8). In September 2020, Covid-19 vaccines were approved and declared to be released by the World Health Organisation and the US Food and Drug Administration (FDA) (9). Pfizer BioNTech and Moderna vaccines received approval from the FDA to be released as an emergency to individuals aged 16 years old and above in mid-December 2020 (4). This approval stems from the lack of specific treatment for Covid-19 infections. In May 2021, the US Food and Drug Administration stated that the use of Pfizer-BioNTech and Moderna vaccines has been expanded to those aged between 12 and 15 years old. All FDA-approved vaccines are subjected to a standard process of reviewing the effectiveness, safety, and quality of the products used in producing the vaccines (10). This study aims to determine the severity level of allergy symptoms among the Malaysian adult population post-Covid-19 vaccination. Malaysians are being recruited because localized data can provide insights for public health policies and initiatives tailored to Malaysia and focusing on one nationality reduces variability due to differing healthcare systems, vaccine types, or public health strategies between countries.

One study evaluated the safety, tolerability, pharmacokinetics, and immunogenicity of JMB2002, a monoclonal antibody against the SARS-CoV-2 receptor binding domain, in healthy Chinese adults (11). A total of 40 participants were randomized to receive a single intravenous dose of JMB2002 at one of four dose levels (5 mg/kg, 10 mg/kg, 25 mg/kg, or 50 mg/kg) or placebo. The results of the study showed that JMB2002 was well-tolerated at all dose levels. The most common adverse events were mild and transient, and included headache, fatigue, and chills. No serious adverse events, dose-limiting events, or adverse events of special interest (such as infusion-related or allergic reactions) were observed (11).

Another study included a cross-sectional analysis of 4318 Covid-19 vaccine-related eConsults that were completed by five allergy specialists between February and October 2021. The most common question types were safety concerns regarding Covid-19 vaccine administration in the setting of prior allergic disease (41.08%) and potential reactions to the first dose of a Covid-19 vaccine (36.1%) (12).

The study's rationale is to better understand the prevalence and risk factors of the allergies due to Covid-19 vaccination. This survey would be useful to estimate the clinical characteristics of Covid-19 vaccine allergies, the effectiveness of current prevention and treatment for Covid-19 vaccine allergies ultimately identify gaps in areas of all vaccine allergies specifically in the severity of allergic reactions. A survey on Covid-19 vaccine allergies would be a valuable tool for public health researchers in developing better ways to prevent, diagnose and treat them.

MATERIALS AND METHODS

A randomized cross-sectional study using an online-based questionnaire was conducted from February 27th, 2022 to June 20th, 2022. The recruited participants were those affected with any symptom of allergic reaction depending on the severity level post-Covid-19 vaccination. Participants with post-vaccination allergic reactions were selected irrespective of manifesting such symptoms either after the first or second dose. At the time of the survey the percentage of people with third booster was low. The sample size estimation was calculated using version 3.1 of OpenEpi software, after considering the population size of Malaysia (aged 18 years and above). This study required approximately 385 respondents with a population size of 22.7 million at a 50% response rate, 95% confidence level, and 5% confidence intervals. A 50% response rate is often used in sample size calculations because it ensures the required sample size is adequate for a range of scenarios. The 50% response rate represents the point of maximum variability or uncertainty in a population and minimizes the risk of under-sampling. The survey was conducted online however the geographical area of the respondents were those resides in West Malaysia. The online platform includes Facebook and WhatsApp groups which are generally used by Malaysian adult. The credibility of this study is confirmed with ethical approvals and the importance of the participant's data input. 5% confidence intervals are the margin of error. We used random sampling method. All members of the population have an equal chance of being selected, we also used stratified random sample at which we look at the percentage of respondent from different characteristic such as age, gender and education level and tried to target the groups that have not answered the survey. With these considerations, we were able to minimize bias. For sample size estimation, the formula used is Cochran formula which is based on the 95% confidence interval, the margin of error is 5% and an assumption of population proportion to be as 50% are required. (n = estimated sample size, N = total population, n = sample size), n = Z2pqe2, Z score for a confidence level of 95%, when a is 0.05 is 1.96, e is the margin of error (5%=0.05), p is the sample population we assume is 50%. q = 1-p. n = (1.96)2(0.5) (0.5)(0.05)2. n = 384.16 ~ 385 respondents therefore, estimated sample size, n = 385 respondents.

Inclusion and Exclusion criteria

The inclusion criteria were Malaysian adults aged 18 years old and above who are currently residing in Malaysia. Pregnant women, lactating women and elderly individuals with comorbidities were included in the study. The exclusion criteria were children or young adults aged below 18 years old and non-Malaysians.

Survey questions

Some of the questions were adapted from four studies (13, 14, 15, 16). The pilot study was performed on 13 volunteers who provided suggestions and feedback. The overall Cronbach's alpha value for the reliability test on the survey questions was 0.757, which exceeds the minimum requirement for an acceptable reliability value. The questionnaire consists of three sections: Section A entails the consent form while Section B focuses on respondents' socio-demographic information. Section C comprises the status of the Covid-19 vaccine, allergic reaction post-Covid-19 vaccination and the booster dose. In terms of previous vaccine data, the questions were presented using three options: Yes, No, and Maybe. In section C, a list of 13 symptoms of allergic reactions was presented to gather allergy information. The options were outlined using a four-point Likert scale ranging from mild, moderate, and severe to very severe. Section C also examined the booster dose data and willingness to pay for Covid-19 vaccination. While self-reporting and online recruitment can introduce biases, implementing these strategies can help mitigate their effects and improve the validity and representativeness of the study results. We conducted a pilot survey to identify and address ambiguities or issues with question design. We ensure the survey is accessible on mobile devices, as many individuals, particularly in rural areas, rely on smartphones for internet access.

Data Analysis

Data was collected online. All data were recorded in the Microsoft Excel spreadsheet and copied to the Statistical Package for the Social Sciences (SPSS) version 26.0 software for final analysis. Descriptive statistics including frequencies and percentages were computed to summarize respondents' socio-demographic characteristics, sources of knowledge on Covid-19 vaccination, Covid-19 vaccination status, allergic reaction data and status for a booster dose. Chi Square was used to analyze the data and the statistical significance was defined at a p-value under 0.05.

Ethical Clearance

This research has been approved by the Ethics Committee for Research involving Human Subjects of University Putra Malaysia (JKEUPM) (reference number: JKEUPM-2022-034). The participants consented to participate in this survey by volunteering to answer and submit the questionnaire.

RESULTS

Socio-demographic data

A total of 315 respondents participated in the online questionnaire from February 27th to June 20th, 2022. Thus, a response rate of 81.6% was achieved as the questionnaires were initially sent to 385 individuals. Descriptively, most of the respondents were females and from the age group of 21 to 30 years old. Women may feel more inclined to comply with social expectations, which might include engaging in surveys as a form of social responsibility. They may view survey participation as a way to contribute to society, help research, or support a cause.

The respondents were Malaysian citizens of Malay, Chinese, and Indians ethnicity. The associations between age, race, and gender with allergy were analyzed using chi-square tests. For age and allergy, the chi-square test yielded a value of $\chi^2 = 0.842$ with 4 degrees of freedom (df) and a p-value of 0.932, indicating no statistically significant association. The association between gender and allergy ($\chi^2 = 0.444$, df = 1, p = 0.505), also showed no statistical significance. Similarly, the analysis of race and allergy ($\chi^2 = 0.065$, df = 3, p = 0.995), confirming no significant association in the study population.

The states in Malaysia were categorized into Zone A (Perlis, Kedah, Penang and Perak), Zone B (Kelantan, Terengganu and Pahang), Zone C (Selangor, Kuala Lumpur and Putrajaya), Zone D (Negeri Sembilan, Melaka and Johor), Zone E (Sarawak), and Zone D (Sabah). Most of the respondents (38.2%) came from Zone A and 92.7% had tertiary education backgrounds (Table I).

Table I: Socio-demographic characteristics of participants based on the age groups, gender, ethnicity, state, highest level of education, occupation, and income classification.

Variables		Participants n (%)		
		Total 315 (100)	Male 75 (23.9)	Female 240 (76.1)
Age Groups	18-20	39 (12.4)	11 (14.7)	28 (11.7)
	21-30	182 (57.6)	41 (54.7)	141 (58.8)
	31-40	37 (11.8)	7 (9.3)	30 (12.5)
	41-50	23 (7.3)	1 (1.3)	22 (9.2)
	Above 50	34 (10.8)	15 (20.0)	19 (7.9)
Ethnicity	Malay	284 (90.4)	67 (89.3)	217 (90.4)
	Chinese	22 (6.7)	6 (8.0)	16 (6.7)
	Indian	6 (1.9)	1 (1.3)	5 (2.1)
	Others	3 (1)	1 (1.3)	2 (0.8)
State	Zone A	120 (38.2)	29 (38.7)	91 (37.9)
	Zone B	34 (10.8)	4 (5.3)	30 (12.5)

CONTINUE

Table I: Socio-demographic characteristics of participants based on the age groups, gender, ethnicity, state, highest level of education, occupation, and income classification. (CONT.)

Variables		Participants n (%)		
State	Zone C	105 (33.4)	27 (36.0)	78 (32.5)
	Zone D	51 (15.9)	14 (18.7)	37 (15.4)
	Zone E	2 (0.6)	0	2 (0.8)
	Zone F	3 (1)	1 (1.3)	2 (0.8)
Highest level of Education	No formal education	0	0	0
	Primary education	0	0	0
	Secondary education	22 (7)	12 (16.0)	10 (4.2)
	Tertiary education	293 (92.7)	63 (84.0)	230 (95.8)
Occupation	Government	54 (17.8)	6 (8)	48 (20)
	Non-government	46 (14.6)	14 (18.7)	32 (13.3)
	Businessman	7 (2.2)	3 (4)	4 (1.7)
	Student	182 (57)	41 (54.7)	141 (58.8)
	Unemployed	26 (8.3)	11 (14.7)	15 (6.3)
Income classification	B40	150 (47.8)	36 (48.0)	114 (47.5)
	M40	112 (35.4)	25 (33.3)	87 (36.3)
	T20	53 (16.9)	14 (18.7)	39 (16.3)

In terms of income classification, the income for the bottom 40% of the Malaysian population (B40) group was below RM4850, the middle 40% of the Malaysian population (M40) group was between RM4851 to RM10,970 and the top 20% of Malaysian population (T20) was above RM10,971. A higher proportion of the respondents were in the B40 group. Pfizer-BioNTech vaccine is distributed across the income brackets, with a slightly higher number of recipients in the B40 category (51.0%) compared to M40 (33.5%) and T20 (15.5%). Sinovac-CoronaVac has similar pattern of distribution with Pfizer-BioNTech with B40 category has the highest number of recipients (47.7%), followed by M40 (37.2%), and T20 (15.1%). Most individuals who received the AstraZeneca vaccine fall under the B40 income bracket (40.5%) followed by M40 group (37.8%) and T20 group (21.6%).

Allergic reaction post-Covid-19 vaccination

Most respondents received Pfizer-BioNTech (48.9%), followed by Sinovac-CoronaVac (27.4%), and AstraZeneca (23.6%). About 52.2% of respondents who had allergy symptoms received mRNA-based vaccines (Pfizer-BioNTech), while viral vector vaccines (AstraZeneca) and inactivated virus vaccines (Sinovac-CoronaVac) were 23.9% each. Notably, only 15.6%, 14.9%, and 12.8% of respondents that received Pfizer-BioNTech, AstraZeneca, and Sinovac-CoronaVac had allergy symptoms, respectively. The association between brand and allergy severity (mild, moderate, severe and very severe) was examined. The chi-square value is χ^2=3.932 (df=6) and p-value is 0.69, thus there is no significant association between the brand and the severity of allergy in the dataset analyzed (Table II).

Table II: Participants with vaccine type and post vaccination allergy.

	Vaccine type			
	Pfizer-BioNTech	**AstraZeneca**	**Sinovac-CoronaVac**	**Total**
Total participants	155	74	86	315
Percentage of total received	49%	23.6%	27.4%	
Allergy count	24	11	11	46
Percentage from total respondents with allergy post vaccine	52.17%	23.9%	23.9%	

	Severity of allergy				Total participants
	Mild	**Moderate**	**Severe**	**Very severe**	**with post Covid-19 vaccination allergy**
Pfizer-BioNTech	3	9	8	4	24
Expected frequency	3.067	8.689	7.667	3.578	
AstraZeneca	3	3	3	2	11
Expected frequency	1.467	4.156	3.667	1.711	
Sinovac-CoronaVac	-	5	4	2	11
Expected frequency	1.467	4.156	3.667	1.711	

N=46; no significant association between type of vaccine and allergy severity (p>0.05)

In terms of the severity of allergic reactions, 14.6% of the respondents provided affirmative responses. Specific allergic reactions with the most common were itchiness at the injection site (9.5%), itchy skin (6.7%), swollen ankles and feet (4.5%), swelling of lips and mouth (3.8%), eczema (3.8%) and urticaria (6.1%). There is no significant association between each symptom's level of severity with the type of vaccine (p>0.05). (Table III).

Table III: Participants with superficial allergic reaction post Covid-19 vaccination according to severity level.

Allergic Reactions	Severity level	Participants n (%)	X^2	p-value
Itchiness at injection site	Not related	283 (90.1)		
	Mild	15 (4.8)		
	Moderate	8 (2.5)	4.48	0.811
	Severe	5 (1.6)		
	Very severe	2 (0.6)		
Skin itchines**S**	Not related	292 (93.3)		
	Mild	13 (4.1)		
	Moderate	3 (1.0)	7.41	0.493
	Severe	2 (0.6)		
	Very severe	3 (1.0)		
Swollen ankle or feet	Not related	300 (95.5)		
	Mild	11 (3.5)		
	Moderate	3 (1.0)	1.80	0.772
	Severe	0		
	Very severe	0		
Swelling of lips and mouth	Not related	302 (96.2)		
	Mild	10 (3.2)		
	Moderate	1 (0.3)	1.12	0.891
	Severe	1 (0.3)		
	Very severe	0		
Eczema	Not related	302 (96.2)		
	Mild	7 (2.2)		
	Moderate	4 (1.3)	3.90	0.690
	Severe	0		
	Very severe	1 (0.3)		
Urticaria	Not related	295 (93.9)		
	Mild	10 (3.2)		
	Moderate	3 (1.0)	8.71	0.190
	Severe	6 (1.9)		
	Very severe	0		

No significant association between each symptom's level of severity with the type of vaccine (p>0.05)

The respiratory symptoms, such as shortness of breath, wheezing, urticaria, asthma attack, runny nose, vomiting, allergic rhinitis, and anaphylaxis were experienced by some respondents. Most respondents had mild allergic reactions characterized by shortness of breath, wheezing, runny nose, wheezing, itchiness at the injection site, and skin itchy. The least experienced allergy symptom was anaphylaxis (0.9% respondent), which was either mild or severe. There is no significant association between each symptom's level of severity with the type of vaccine (p>0.05) (Table IV).

Table IV: Participants with respiratory allergic reaction post Covid-19 vaccination according to severity level.

Allergic Reactions Post Covid-19 Vaccination	Severity level	Participants n (%)	X^2	p-value
Shortness of breath	Not related	288 (91.7)		
	Mild	16 (5.1)		
	Moderate	6 (1.9)	2.96	0.813
	Severe	3 (1.0)		
	Very severe	1 (0.3)		
Wheezing	Not related	295 (93.9)		
	Mild	16 (5.1)		
	Moderate	1 (0.3)	5.43	0.245
	Severe	2 (0.6)		
	Very severe	0		
Asthma attack	Not related	298 (94.9)		
	Mild	10 (3.2)		
	Moderate	3 (1.0)	7.38	0.287
	Severe	2 (0.6)		
	Very severe	1 (0.3)		
Runny nose	Not related	294 (93.6)		
	Mild	14 (4.5)		
	Moderate	3 (1.0)	8.82	0.357
	Severe	1 (0.3)		
	Very severe	2 (0.6)		
Allergic rhinitis	Not related	296 (94.3)		
	Mild	11 (3.5)		
	Moderate	4 (1.3)	3.05	0.802
	Severe	2 (0.6)		
	Very severe	1 (0.3)		
Anaphylaxis	Not related	311 (99)		
	Mild	2 (0.6)		
	Moderate	0	2.32	0.677
	Severe	1 (0.3)		
	Very severe	0		

No significant association between each symptom's level of severity with the type of vaccine ($p>0.05$)

Start and duration time of allergic reaction post-Covid-19 vaccination

Twenty-six respondents reported that their allergy symptoms occurred in "less than 24 hours" after vaccination. Meanwhile, 3.18%, 2.54%, and 0.63% of respondents had allergy "after 24 hours", "within 1 week" and in "less than 1 hour", respectively. Having allergy symptoms in less than an hour was considered acute. Regarding the time required to complete recovery for post-vaccination symptoms, 8.28% of respondents reported less than a week after symptoms onset, 3.5% of respondents chose less than a month, 1.59% chose more than a month and only 1.27% respondents recovered in less than a day. There is a significant association between the start of allergic reaction and the duration of allergic reaction in the study population (χ^2=21.90, df=9, p-value= 0.0092) (Table V).

Table V: The total occurrence of the start of allergy and duration of allergy with the observed value and expected frequency.

		Duration of allergy			
		Less than 24 hours	**Less than a week**	**Less than a month**	**More than a month**
Start of allergy	**Less than 1 hour**	-	2	-	-
	Expected frequency	0.13	1.33	0.31	0.22
	Less than 24 hours	3	2	19	1
	Expected frequency	1.67	16.67	3.89	2.78
	After 24 hours	1	8	-	1
	Expected frequency	0.67	6.67	1.56	1.11
	Within 1 week	-	1	3	4
	Expected frequency	0.53	5.33	1.24	0.89

n=46; A significant association between the start of allergic reaction and the duration of allergic reaction in the study population (p-value < 0.05).

DISCUSSION

Herd immunity can only be achieved in a country when most of the population is vaccinated. Nevertheless, a few individuals might experience some side effects during a national vaccination programme, especially with a novel vaccine. The present study reflected that 14.6% experienced allergic reactions after receiving Covid-19 vaccines. Notably, most respondents had mild allergy symptoms, whereas less than three manifested very severe levels of superficial symptoms, such as itchiness at injection sites, skin itchiness, and eczema. Meanwhile, respiratory and gastrointestinal categories included shortness of breath, asthma attacks, runny noses, vomiting, and allergic rhinitis. All respondents with mild to severe levels of symptoms were not being hospitalized. According to a study conducted in Croatia, the risk of severe allergic reactions toward mRNA vaccines is low and rarely occurs (17). Nonetheless, allergy may occur in any Covid-19 vaccine depending on individuals' allergy history and experience. Nittner-Marszalska et al. (18) also stated both that individuals with and without a history of allergic reactions received Pfizer-BioNTech vaccines and they had a lower risk of post-vaccination allergic reaction.

The mRNA vaccines such as Pfizer BioNTech and Moderna entailed the same technology, which involves mRNA molecules surrounded by lipid nanoparticles (LNPs) that are attached to polyethene glycol (PEG) molecules to provide stability of mRNA molecules and increased life span (17). The presence of PEGs elicited the activation of complement and mediators, thus leading to an allergic reaction (17). According to the reports by the US Department of Health and Human Services (2021), 80% of patients who experienced anaphylaxis after receiving the mRNA-1273 vaccine have an allergy history after receiving medications containing Polyethylene glycol (PEG).

The polysorbate 80 (PS80) and polyethene glycol (PEG) contained in vaccines related to adenovirus vectors, caused allergic reactions. Nevertheless, the severity level was lower compared to PEG (6). However, it was reported that polysorbate 80 can be found in pharmaceutical and food products as an emulsifier and stabilizer (6). In vaccination, polysorbate 80 is used to ensure the solubility of AZD1222 vaccines during the injection process. In addition, one study (19) reported that the most concerning adverse effect post-Covid-19 vaccination in Malaysia are arrhythmia, which occurred within one to seven days post-vaccination. The risk of thrombocytopenia upon receiving Covid-19 vaccines was higher among those that received AstraZeneca vaccines, but the cases remained low and rarely occur in the Malaysian population.

The present study also depicted that most respondents posited that the duration of allergic reaction started less than 24 hours' post-vaccination and recovery was less than a week after symptoms onset. In comparison to a previous study conducted in Saudi Arabia, the study (20) reported a median duration of adverse effects, including allergy symptoms occurring within the two days post-vaccination and recovery within three days. Recent research in Malaysia suggested that adverse effects were presented in individuals within 3 weeks after vaccination (21). Nonetheless, other symptoms involving fever, dizziness, body aches and fatigue persisted for more than two weeks (21). Thus, severe allergic reactions rarely occurred and it took a few days for other allergy symptoms to disappear without any treatment.

Severe allergic reactions involving anaphylaxis were reported in the United States, among 11 recipients, eight female and three male adults, within 15 to 30 minutes after receiving the Pfizer-BioNTech vaccine (22). The researchers concluded that the cases of severe allergic reactions are low among the US population (22). In Iraq and Jordan, mild allergic reactions involving localized redness and swelling at the injection site, urticaria, and facial and lip swelling might occur in individuals who are allergic to certain ingredients (23). A study conducted by researchers at the Medical University of Wroclaw, Poland found that mild reactions disappeared following treatment with intramuscular epinephrine injection (18). Hatmal and his colleagues (13) also documented post-vaccination side effects, in which most Covid-19 vaccine recipients reported mild (39%) and moderate (21%) reactions. Meanwhile, severe side effects were only observed in 10% based on the type of vaccine received. Moreover, cases of severe allergic reactions such as anaphylaxis were rarely reported and the symptoms might persist only for a short time.

One study reported the occurrence of allergic reactions following the recognition of pre-existing antibodies with the vaccine ingredients (24). For instance, Pfizer-BioNTech and Moderna vaccines contain polyethene glycol 2000 (PEG2000), which triggers IgE directed against PEG and forms anti-PEG IgE. Anti-PEG IgE binds to mast cells and activates the complement system, which culminates in non-classical anaphylaxis (24). Complement activation and the release of mediators due to the mediation of IgM and IgG antibodies against PEG, allergic reactions are elicited via the complement activation-related pseudo-allergy reaction (CARPA) (17). Hence, CARPA is an allergic reaction non-mediated by IgE, which might induce the dissemination of anaphylatoxins in the bloodstream (6). While the technology in two different brand vaccines may be the same, variations in formulation ingredients, manufacturing processes, delivery methods, and even demographic factors can lead to different allergic reaction percentages. These factors can influence the immune response, causing variations in the frequency and severity of allergic reactions between the two brands.

One study from Turkey reported on 2,175 participants who received Covid-19 vaccines at 15 different hospitals in Turkey. Of these, 72 (3.3%) participants reported cutaneous reactions after vaccination (25). The most common type of cutaneous reaction was a local reaction at the injection site (63.8%), followed by generalized urticaria (24.7%). Other types of cutaneous reactions included angioedema (6.9%), erythema multiforme (1.4%), and Stevens-Johnson syndrome (0.7%). The study found that the risk of cutaneous reactions was higher in women than in men, higher in younger participants and participants with a history of allergic diseases (25).

The study concluded that cutaneous reactions are a relatively rare but serious adverse event after Covid-19 vaccination (25). The risk of cutaneous reactions is higher in women, younger participants, and participants with a history of allergic diseases. This finding is similar to a recent study done in Terengganu (26). The limitation of the study was that it was a retrospective study, which means that the data was collected after the participants had already been vaccinated. This could lead to recall bias, as participants may not remember their reactions accurately.

One review which covers the prevalence, types of reactions, risk factors, pathogenesis and treatment reported that cutaneous and allergic reactions are relatively rare, but they have been reported following all types of Covid-19 vaccines (27). The most common cutaneous reactions are local reactions at the injection site, such as erythema, swelling, pain, and itching. Other types of cutaneous reactions include generalized urticaria, angioedema, erythema multiforme and Stevens-Johnson syndrome. Allergic reactions can range from mild to severe, and they can occur immediately after vaccination or days or weeks later. The risk of cutaneous and allergic reactions is higher in women, younger participants, and participants with a history of allergic diseases. The exact mechanism of cutaneous and allergic reactions to Covid-19 vaccines is not fully understood. However, it is thought that these reactions are caused by an overreaction of the immune system to the vaccine. Most cutaneous and allergic reactions to Covid-19 vaccines are mild and self-limited. However, some reactions may require treatment with antihistamines or corticosteroids. In severe cases, hospitalization may be necessary.

The risk of these reactions is higher in certain groups of people, such as women, younger participants, and participants with a history of allergic diseases. Healthcare providers should be aware of the potential for these reactions and be prepared to treat them promptly.

Another review reported on the similarities between cutaneous reactions due to SARS-CoV-2 infection and Covid-19 vaccination such as Maculopapular rash, Urticaria, Erythema multiforme, Stevens-Johnson syndrome, Chilblain-like lesions, Vasculitis and Pityriasis rosea (27). These similarities may be because both the virus and the vaccines activate the immune system in a similar way in which the immune system produces antibodies to fight off the infection. In some cases, this immune response can also damage the skin, resulting in a cutaneous reaction (28).

Cutaneous reactions are generally more common in people with a history of allergies or other autoimmune diseases (29). This suggests that these people may be more susceptible to the immune-mediated reactions that can cause cutaneous reactions. Cutaneous reactions are relatively rare but they are important side effects of SARS-CoV-2 infection and Covid-19 vaccination. Healthcare providers should be aware of the potential for these reactions and be prepared to manage them appropriately (30).

Our study was conducted during a period of strict social distancing rules therefore the respondents had to complete the surveys online, however they might need further explanation on certain questions. The respondents might be under- or over-reporting their allergies, have difficulty recalling their allergic reactions and their severity and they might not be equally represented in any age and gender (28).

CONCLUSION

In conclusion, most of the respondents do not report any allergic reaction but for those who reported allergy reaction, most reported mild symptoms when asked about their severity level of allergic reaction while few with very severe symptoms rarely occurred. The

results also showed that social media gave huge impact in influencing people's perception towards Covid-19 vaccination and it was found to be the most chosen platform to receive information regarding Covid-19 vaccination programme. There was no significant association between education level and income classification with the booster acceptance. The booster vaccination was found lower among the adults, therefore promoting Covid-19 vaccination booster campaign throughout online platforms and physical events is encouraged.

Vaccine education should be done through targeted campaigns, healthcare provider training, addressing specific allergy concerns, and engaging with the community. With this methods, public confidence in vaccination can be significantly enhanced. These efforts should emphasize transparency, provide clear and accessible information, and help individuals make informed decisions about vaccination, ultimately leading to better vaccine acceptance and reduced allergic reactions. By addressing concerns through targeted education and transparent communication about the actual risks of allergic reactions, public health campaigns can build trust and encourage more people to get vaccinated. This leads to higher vaccination rates, which is essential for achieving herd immunity.

There are limitations in this study. The severity of allergic reactions was self-reported, which could lead to underreporting or overreporting due to subjective perceptions or recall bias. Cultural, geographical, or demographic factors could influence perceptions and behavior differently. Social media might influence vaccine perceptions and those favoring vaccination would be more likely to engage with related content online. Other potential factors influencing booster vaccine acceptance, such as accessibility, availability, or personal health concerns should be investigated. The recommendation for online and physical campaigns lacks specific evidence on what methods or platforms are most effective in promoting booster uptake. This study provides a snapshot of attitudes and behaviors at one point in time, which might not capture evolving perceptions or trends. Therefore, it is recommended that in future, evolving perceptions and trends should be included in the study.

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