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IDENTIFICATION OF FACTORS INFLUENCING REFUSAL COVID-19 VACCINE USING FAHP

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ABSTRACT

The pandemic Coronavirus (COVID-19) has spread rapidly worldwide, initially emerging in China. It had spread to more than 180 nations and infected more than 18.4 million people just over six months as recorded in August 2020. Thus, all countries were fighting to get rid of this virus and to find a vaccine. The COVID-19 vaccine is currently being offered to people who qualify, but many Malaysians chose not to sign up to receive the immunization. The initial booster dose of vaccine was only administered to half of the nation's total population. Studying the motivational elements and health beliefs that influence vaccination decisions is necessary. Therefore, the objective of this study is to identify the factors that influence the refusal of the Covid-19 vaccine. The Statistical Package for the Social Sciences (SPSS) will be used to assess the correlation analysis of the variables impacting COVID-19 vaccine rejection. As part of the investigation, the Fuzzy Analytics Hierarchy Process (FAHP) will be used to investigate associated factors. Considered were seven variables that affect vaccine refusal. The finding showed the perception of vaccine safety, and its effectiveness factor is the highest correlation that influences the refusal of the vaccine. It is followed by social factors, the rumours spread by the media, education level, previous experience, knowledge, and public health policies. Furthermore, the result from the FAHP method shows that previous experience is the top-rank factor influencing the refusal of the COVID-19 vaccine since it has a high weight value. The second rank is knowledge, followed by education, public health policies, social, perception of vaccines, and the rumour spread by media. This research contributes to the understanding of the factors influencing Covid-19 vaccine refusal in Malaysia and provides possible targeted vaccination campaigns that are appropriate and effective towards increasing population immunity.

Keywords*: COVID-19 Vaccine, Fuzzy Analytics Hierarchy Process (FAHP), Refusal factors, SPSS.*

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1. Introduction

Coronavirus disease (COVID-19) initially emerged in China as an infectious disease caused by the SARS-CoV-2 virus. Wuhan Municipal Health and Health Commission has first issued an official document entitled “emergency notice on reporting the treatment of pneumonia of unknown cause”. These findings were reported to the World Health Organization (WHO) in December 2019. WHO issued a preparedness warning to all countries in January 2020 and declared the spread of COVID-19 as a global health emergency or global health state of emergency (Mohamad et al., 2021).

The virus then spread to neighbouring countries such as Thailand, Malaysia, Korea, Japan, Europe, America, and Africa (Pal et al., 2020). With more than 2,400,000 cases and 170,000 deaths reported in April 2020, the COVID-19 pandemic is a global health crisis that impacts citizens of all countries. It has spread to more than 180 nations and infected more than 18.4 million people in just over six months since the virus was first spotted in mainland China, as recorded in August 2020 (Rajkumar, 2020).

Based on the Ministry of Health (MOH) report, there were new confirmed cases and new clusters daily in Malaysia. According to Che Mat et al. (2020), the first case in Malaysia was reported in January 2020, and then positive cases gradually increased to 22 cases in February 2020, which remained plateau for nearly two weeks. The infectious count has an upward trend until mid-March 2020 (Idris et al., 2022). Malaysia has recorded the highest number of COVID-19 cases in Southeast Asia, with 4817 cases and 77 deaths by April 2020. The distribution of Covid-19 cases during the third wave was reported at 83,142 cases in December 2020.

Since new cases in Malaysia have been rising as stated by the MOH, the government enforced a Movement Control Order (MCO) starting on March 18, 2020, to prevent the virus from spreading, thus avoiding another increase in new cases. All Malaysians were advised to stay inside during MCO, according to research by Aziz et al. (2020). Only the family's head is permitted to visit the supermarket to buy needs like food, groceries, and other things. Subsequently, on May 4, 2020, the government enforced the Conditional Movement Control Order (CMCO), followed by the Recovery Movement Control Order (RMCO) on July 10, 2020.

WHO (2022) confirmed that the virus spreads from the nose or mouth of an infected person in the form of small liquid particles when they talk, cough, sneeze or breathe. A person can contract COVID-19 if they breathe or inhale the virus, are in close proximity to someone infected with it, or touch a contaminated surface, then touch their mouth, nose, and eyes. The virus spreads more easily indoors and in crowded environments. Most individuals infected with COVID-19 will experience mild to moderate symptoms and recover without any hospital treatment. However, some will have severe symptoms and require medical attention.

Mohamad et al. (2021) explained that the structure of this virus is durable, infectious, and comes in different forms. In general, it is spherical in shape and covered by a protective layer known as a “glycoprotein”, which plays a role in binding the cells of a person’s body and weakening the immune system. The viral nucleus, which is the heart of the virus, contains RNA (Ribonucleic acid), which mutates frequently. This structure adds to scientists’ complexity in creating a vaccine to eradicate this virus. Doctors use this RNA structure to diagnose a patient with a specific test.

The COVID-19 coronavirus possesses protein spikes on each of its viral particles. These spikes help the viruses more easily enter the cells. Some coronavirus vaccinations are made to help the body "recognize" these spike proteins and fight the coronavirus that contains them. An effective vaccine protects the receiver from fatal illnesses, hospital stays, and other serious complications. The widespread use of vaccination will aid in reducing the virus's ability to spread through populations and evolve into new strains (Johns, 2022).

The COVID-19 vaccination program in Malaysia is a campaign from the Malaysian government to prevent the spread of COVID-19 and end the COVID-19 pandemic in Malaysia by achieving herd immunity among Malaysians and non-Malaysians. Following the approval by the Malaysian Cabinet, Malaysia's Minister of Science, Technology, and Innovation (MOSTI) has been named as the coordinating minister for the immunization program. The COVID-19 Vaccine Supply Access Guarantee Special Committee (JKJAV), co-chaired by MOSTI, was established to ensure the country's COVID-19 vaccine supply is procured in a timely fashion. The immunization program, which began in February 2021, with the Malaysian

Prime Minister was among the first to receive the Covid-19 vaccine as a symbol of leadership and confidence in the vaccination campaign.

Even though the vaccines are sufficient, only 86.6%, 84.2%, 50.0%, and 2.5% of Malaysians had received the first dose, second dose, first booster, and second booster, respectively, as recorded on September 3, 2023 (KkmNow, 2023). Despite being aware that diseases can strike at any time and have not yet abated, this declining demand shows that many Malaysians are refusing vaccination. Vaccine reluctance is a worldwide health issue that must be addressed to stop the spread of COVID-19. As demonstrated by the COVID-19 pandemic, the prevalence of vaccine hesitancy will increase the risk for extremely vulnerable individuals, such as the elderly or those with pre-existing medical issues (Jafar et al., 2022).

To enable the development of tailored vaccination programs that are appropriate and effective in raising population immunity, it is necessary to conduct a study on the factors that impact people's decision to get immunized as well as their opinions on health. The perception of vaccine safety and effectiveness, societal variables, media-spread rumours, education level, prior experience, expertise, public health regulations, and other considerations were among the many distinct grounds for refusing vaccination (Arcadio & Leidy, 2021). Therefore, the primary goal of this research is to pinpoint the variables influencing Malaysians' decision to refuse the COVID-19 vaccine. There were seven factors that influenced the refusal of the vaccine were considered; the perception of vaccine safety and its effectiveness, social factors, the rumours spread by the media, education level, previous experience, knowledge, and public health policies. The specific goal is to identify and prioritize the relevant elements that affect vaccine refusal.

This study used Statistical Package for the Social Sciences (SPSS) to perform correlation analysis in determining the factors of vaccine refusal. SPSS is a program used by various researchers to perform complex statistical data analysis. It is an effective tool for quantitative data analysis in different fields of study. It has been evident that SPSS is considered one of the most important and influential statistical tools for quantitative data analysis (Rahman & Muktadir, 2021). According to Emad et al. (2021), SPSS was found to be the most widely used statistical software in the selected study periods. Based on the hypothesis that each component may contribute to or have an impact on others, this study seeks to determine the correlation between each factor. The linearity of the relationship between those variables is confirmed using Pearson's correlation.

As part of the investigation, the Fuzzy Analytics Hierarchy Process (FAHP) will be used to investigate associated factors. FAHP was created to provide different decision-making and solve hierarchical and ranking problems (Mahat & Zulkofli, 2020). Interval decisions were generally more confident than fixed value judgments for decision-makers. In the previous study, the FAHP method was applied in ranking problems and has been shown to be more in conformity with reality (Khashei et al. (2020), Loh et al. (2020)).

2. Methodology

2.1 Pearson’s Correlation

The primary data for this research was collected through a questionnaire administered via a Google Form, with the objective of identifying the refusal of Covid-19 vaccine and its influencing factors, as well as conducting correlation analysis among these factors. This questionnaire consists of four sections. The first section includes the respondents' demography such as age, ethnicity, and religion. The second section is about health status, and the third section is about refusal factors of the COVID-19 vaccine. The last section questions about the awareness and importance of rejecting the COVID-19 vaccine.

The sampling method employed in this study involved random selection of individuals in Malaysia who were eligible for the Covid-19 vaccine and had access to the internet to fill the Google Form survey. A total of 171 participants took part in the survey. The questionnaire incorporated several factors of vaccine refusal which were education, knowledge, previous experience, social factor, public health policy, the rumors spread by media and perception of vaccine safety. These factors were included in the survey to gather insights into their impact on individuals' refusal of Covid-19 vaccine.

In this study, SPSS was utilized to conduct the Pearson Correlation analysis. Pearson Correlation is a statistical method used to measure the strength and direction of the linear relationship between two variables. The correlation coefficients obtained from the analysis were interpreted according to the guidelines provided in Table 1, which lists the interpretation of correlation coefficients.

Table 1. Rule of Thumb the size of correlation coefficient.

Size correlation	Interpretation
1	Perfect (positive/negative) correlation
±0.99 to ±0.99	Very high (positive/negative) correlation
±0.70 to ±0.90	High (positive/negative) correlation
±0.50 to ±0.70	Moderate (positive/negative) correlation
±0.30 to ±0.50	Low (positive/negative) correlation
±0.10 to ±0.30	Very Low (positive/negative) correlation
±0.00 to ±0.10	Negligible (positive/negative) correlation

2.2 Implementation of FAHP

The implemetation of FAHP was starting by collecting the data at the vaccination centre, Dewan Apam Putra, Pasir Mas, Kelantan. The aim of collecting this data is to identify which factor influenced the most refusal of the COVID-19 vaccine. The data used the FAHP approach to rank the related factors. In general, the implementation of Fuzzy Hierarchy Process begins with the preparation of questionnaires and interviews with experts in the field. The questionnaire is prepared based on factors that have been identified through Pearson Correlation Analysis as having a relationship with the reason for rejecting the vaccine. Then the questionnaire was asked through an interview to the experts, that are, the doctors on duty of screening potential vaccine recipients at the vaccination centre. The respondents will be guided to determine the suitable Linguistic terms and their corresponding triangular Fuzzy numbers. The triangular scale is very useful to calculate the ranking factors by using Fuzzy Hierarchy Process.

There were seven essential steps in conducting the FAHP as shown in Figure 1 (Mahat et al., 2020).

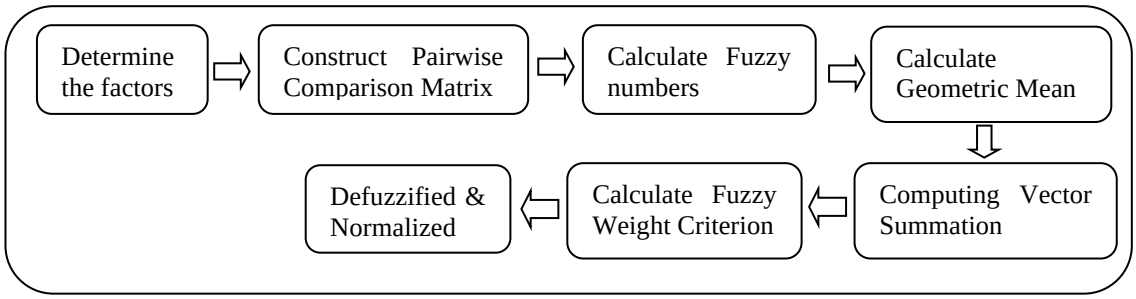

Figure 1. Flowchart of FAHP.

Step 1: In determining the factors, each factor is identified through the linguistic terms and the corresponding scale, as shown in Table 2.

Table 2. The Linguistic Terms and the Corresponding Scale (Othman et al., 2020)

Scale	**Triangular Fuzzy**	**Meaning of scale**	**Triangular Fuzzy**	**Meaning of scale**
1	(1,1,1)	Equally important to both factors	(1,1,1)	Equally unimportant to both factors
3	(2,3,4)	Weakly important	$\left(\frac{1}{2},\frac{1}{3},\frac{1}{4}\right)$	Weakly unimportant
5	(4,5,6)	Very important	$\left(\frac{1}{4},\frac{1}{5},\frac{1}{6}\right)$	Very unimportant
7	(6,7,8)	Strongly important	$\left(\frac{1}{6},\frac{1}{7},\frac{1}{8}\right)$	Strongly unimportant
9	(9,9,9)	Extremely important	$\left(\frac{1}{9},\frac{1}{9},\frac{1}{9}\right)$	Extremely unimportant
2	(1,2,3)	The intermittent levels of importance among two adjacent scales	$\left(1,\frac{1}{2},\frac{1}{3}\right)$	The intermittent levels of unimportant among two adjacent scales
4	(3,4,5)	Intermediate value	$\left(\frac{1}{3},\frac{1}{4},\frac{1}{5}\right)$	intermediate value
6	(5,6,7)		$\left(\frac{1}{5},\frac{1}{6},\frac{1}{7}\right)$	
8	(7,8,9)		$\left(\frac{1}{7},\frac{1}{8},\frac{1}{9}\right)$	

Step 2: By referring to Table 2, the pair-wise comparison matrix, $\tilde{A}^k$, is constructed as in Equation (1). Each criteria alternative's score relates to each criterion and is defined as $\tilde{d}_{ij}^{\,k}$, which referred to the k[th] Expert Selection of i[th] factor over j[th] factor.

$$\tilde{A}^k = \begin{bmatrix} \tilde{d}_{11}^{\,k} & \tilde{d}_{12}^{\,k} & \ldots & \tilde{d}_{1n}^{\,k} \\ \tilde{d}_{21}^{\,k} & \ldots & \ldots & \tilde{d}_{2n}^{\,k} \\ \ldots & \ldots & \ldots & \ldots \\ \tilde{d}_{n1}^{\,k} & \tilde{d}_{n2}^{\,k} & \ldots & \tilde{d}_{nn}^{\,k} \end{bmatrix} \quad (1)$$

Step 3: The fuzzy number of factors is calculated by using the formula in Equation (2). The value of $\left(\tilde{d}_{ij}^{\,k}\right)$ is the average of experts' preferences and K is the number of experts.

$$\tilde{d}_{ij} = \frac{\sum_{k=1}^{K} \tilde{d}_{ij}^{k}}{K} \tag{2}$$

Step 4: Using the formula in Equation (3), the geometric mean of the fuzzy relation and the values of each criterion are calculated where *n* is the number of factors taken from the pair-wise comparison matrix in Equation (2).

$$\tilde{r}_i = \left(\prod_{j=1}^{n} \tilde{d}_{ij} \right)^{1/n} \text{ where } i = 1,2,...,n. \tag{3}$$

Step 5: For each criterion, the fuzzy weight is calculated by computing the vector summation $\tilde{d}_i$ for each $\tilde{r}_i$ by using Equation (4). Find the (-1) power of the summation vector and replace the fuzzy triangular number to make it in increasing order.

$$\tilde{d}_i = \left(\tilde{t}_1 \oplus \tilde{t}_2 \oplus ... \tilde{t}_n \right) \tag{4}$$

Step 6: The fuzzy weight of criterion, $\tilde{w}_i$, is calculated and each $\tilde{r}_i$ is multiplied with the reverse vector. The formula for $\tilde{w}_i$ is shown in Equation (5).

$$\tilde{w}_i = \tilde{r}_i \otimes \left(\tilde{r}_1 \oplus \tilde{r}_2 \oplus ... \tilde{r}_n \right)^{-1} = \left(lw_i, mw_i, uw_i \right) \tag{5}$$

The variable *l* refers to the lower number of increasing orders of $\tilde{d}_i$, *m* refers to the median number of increasing orders of $\tilde{d}_i$, and *u* refers to the upper number of increasing orders of $\tilde{d}_i$.

Step 7: The fuzzy weight is defuzzified and normalized. By using the center of area defuzzification, the fuzzy weight, $\tilde{w}_i$ is defuzzified since they are still fuzzy triangular numbers by applying Equation (6). Then, it is normalized by using Equation (7).

$$M_i = \frac{lw_i + mw_i + uw_i}{3} \tag{6}$$

$$N_i = \frac{M_i}{\sum_{i=1}^{n} M_i} \tag{7}$$

By following the seven steps provided, the criterion with the highest score is suggested as the most important criterion.

3. Results and Discussion

The correlation results of analysis on factors influencing refusal of Covid-19 vaccine are displayed in Table 3. The significant cells are the blue and yellow cells and warrant examination. The correlation coefficient, *r*, *p*-value, and number of complete pairwise observations upon which the computation was based are all contained in these cells for the correlation between each factor.

Table 3. Correlation Analysis on Factors Influencing Refusal of Covid-19 Vaccine.

Correlations (Correlation is significant at the 0.01 level (2-tailed).**										
		Social factor	**Perception of vaccine safety and effectiveness**	**Education**	**Previous Experience**	**The rumours spread by the media**	**Knowledge**	**Other**	**Public health policies**	**Refusal the vaccine**
Social factor	P.Corr	1	.540**	.627**	.627**	.241**	.627**	-.013	.627**	.393**
	Sig.		.000	.000	.000	.002	.000	.862	.000	.000
	N	169	169	169	169	169	169	169	169	169
Perception of vaccine safety and effectiveness	P.Corr	.540**	1	.338**	.338**	.416**	.338**	-.025	.338**	.871**
	Sig.	.000		.000	.000	.000	.000	.747	.000	.000
	N	169	169	169	169	169	169	169	169	169
Education	P.Corr	.627**	.338**	1	.494**	-.015	.494**	-.008	1.000**	.317**
	Sig.	.000	.000		.000	.849	.000	.913	.000	.000
	N	169	169	169	169	169	169	169	169	169
Previous Experience	P.Corr	.627**	.338**	.494**	1	.400**	1.000**	-.008	.494**	.317**
	Sig.	.000	.000	.000		.000	.000	.913	.000	.000
	N	169	169	169	169	169	169	169	169	169
The rumours spread by the media	P.Corr	.241**	.416**	-.015	.400**	1	.400**	-.010	-.015	.389**
	Sig.	.002	.000	.849	.000		.000	.894	.849	.000
	N	169	169	169	169	169	169	169	169	169
Knowledge	P.Corr	.627**	.338**	.494**	1.000**	.400**	1	-.008	.494**	.317**
	Sig.	.000	.000	.000	.000	.000		.913	.000	.000
	N	169	169	169	169	169	169	169	169	169
Other	P.Corr	-.013	-.025	-.008	-.008	-.010	-.008	1	-.008	.223**
	Sig.	.862	.747	.913	.913	.894	.913		.913	.003
	N	169	169	169	169	169	169	169	169	169
Public health policies	P.Corr	.627**	.338**	1.000**	.494**	-.015	.494**	-.008	1	.317**
	Sig.	.000	.000	.000	.000	.849	.000	.913		.000
	N	169	169	169	169	169	169	169	169	169
accepting the vaccine	P.Corr	.393**	.871**	.317**	.317**	.389**	.317**	.223**	.317**	1
	Sig.	.000	.000	.000	.000	.000	.000	.003	.000	
	N	169	169	169	169	169	169	169	169	169

All the green cells which make up the main diagonal, have correlations that are all equal to 1. This is due to a variable's inherent perfect correlation with itself. Take note that the sample sizes, N, and the number of respondents are different (N=169 and number of respondents =171, respectively), due to missing data. Two aspects of the outcome are of relevance to this study. The correlation coefficient, or Pearson's *r* value, comes first. A perfect positive correlation (Pearson's $r = 1$) and a perfect negative correlation (Pearson's $r = -1$) are both possible. Zero denotes the absence of any linear correlation. Additionally, the 2-tailed significance values or the *p*-value, which are shown in the yellow cells are of relevance to this analysis. Since the statistical significance, α, is a probability and relates to confidence intervals, its value can be any nonnegative real number that is less than one. The alpha level for this analysis would be 1-0.99, or 0.01 since it needs to be 99 percent confidently accurate.

Based on the results shown in Table 3, the perception of vaccine safety and effectiveness factor and refusal of vaccine have a statistically significant linear relationship and are strongly positively correlated ($0.7 < |r| < 0.9$, $p < 0.01$). These variables tend to increase together, greater perception is associated with greater refusal. On the other hand, the social factor and vaccine refusal were statistically significant, with a p-value of 0.000 which is less than 0.01. With an *r*-value of 0.393, the magnitude, or strength, of the association is low ($0.3 < |r| < 0.5$). The media-spread rumour factor and vaccination rejection, on the other hand, were statistically significant with their p-values being 0.000 less than 0.01, leading to a statistical significance with an *r*-value of 0.389, which has a weakly positive association. The *r*-value for the factors of education, prior experience, knowledge, and public health policy is the same at 0.317, demonstrating a weak positive connection with vaccine refusal.

The findings indicated that the impression of vaccination safety and efficacy was the primary factor most strongly correlated with vaccine refusal for the COVID-19 vaccine. The social element, media-spread rumours, education, prior experience, knowledge, public health policy, and other aspects are placed after it.

On the other hand, the Fuzzy Analytics Hierarchy Process approach was assessed in light of the variables impacting the Covid-19 vaccine refusal. At this stage, each criterion's weight was established using language phrases and their corresponding fuzzy numbers. After completing the first two steps of the procedure, the average fuzzy number was determined. Based on their preferences, the average of each criterion d_{ij} was determined as illustrated in Table 4.

1 Education
2 Knowledge
3 Previous Experience
4 Social Factor
5 Public Health Policy
6 The rumours spread by media
7 Perception of vaccine safety

Table 4. The Average Fuzzy Number.

	1	2	3	4	5	6	7
1	(1,1,1)	(1.417,1.111,0.833)	(1.44,1.167,1)	(1.511,1.250,1.111)	(2.889,2.667,2.667)	(4.444,3.833,3.333)	(3.083,2.778,2.500)
2	(1.333,1.500,1.778)	(1,1,1)	(0.778,0.883,1)	(2.400,2.083,1.778)	(2.833,2.556,2.333)	(4.400,3.750,3.1111)	(2.861,2.611,2.500)
3	(1,1.167,1.444)	(1,1.333,1.667)	(1,1,1)	(2.667,2.333,2.000)	(3.444,3.167,3.000)	(3.194,3.278,3.500)	(3.444,3.167,3.000)
4	(1.500,2.111,2.750)	(1.417,1.733,2.056)	(0.750,0.733,0.772)	(1,1,1)	(1,1,1)	(4.067,3.417,2.778)	(3.082,2.778,2.500)
5	(0.722,1.381,2.042)	(1.389,2.042,2.708	(0.714,1.042,1.370)	(1,1,1)	(1,1,1)	(3.400,3.147,3.444)	(3.083.2.778,2.500)
6	(0.548,0.819,1.120)	(1.214,1.486,1.787)	(1.037,1.704,2.370)	(1.167,1.548,1.792)	(1.222,1.492,1.792)	(1,1,1)	(0.750,0.778,0.833)
7	(1.056,1.381,1.708)	(1.056,1.714,2.375)	(0.714,1.042,1.370)	(1.056,1.381,1.708)	(1.056,1.381,1.708)	(1.333,1.667,2.000)	(1,1,1)

Following that, the geometric mean of the fuzzy comparison was calculated. Equation (8) figures out the overview of computation for the "Previous Experience" factor. Table 5 shows the results of the geometric mean fuzzy comparison value.

$$\bar{r} = [(1x1x1x2.667x3.444x3.194x3.44)^{1/7},(1.167x1.333x1x2.333x3.167x3.278x3.167)^{1/7}, (1.444x1.667x2x3x3x3.5)^{1/7}]$$
$$= (1.934, 1.980, 2.049) \quad (8)$$

Table 5. Geometric Mean of Fuzzy Comparison Value.

Factor	**GEOMETRIC MEAN**		
Education	1.987	1.728	1.540
Knowledge	1.898	1.816	1.783
Previous experience	1.934	1.980	2.049
Social factor	1.534	1.588	1.613
Public health policies	1.334	1.609	1.816
The rumour spread by media	0.957	1.207	1.438
Perception of vaccine	1.024	1.342	1.644

The fuzzy weight of each factor was calculated in the fifth step. As a result, Equation (9) indicates the relative fuzzy weight calculation for the criteria “Previous Experience”. Table 6 shows the relative fuzzy weight value for all factors.

$$w=(1.934, 1.980, 2.049) \text{ x } (0.112, 0.130, 0.154)$$
$$= [(1.934 \text{ X } 0.112), (1.980 \text{ X } 0.130), (2.049 \text{ X } 0.154)]$$
$$= (0.217,0.257,0.316) \quad (9)$$

Table 6. Relative Fuzzy Weight each Factors.

Factor	**FUZZY WEIGHT**		
Education	0.223	0.224	0.237
Knowledge	0.212	0.236	0.274
Previous experience	0.217	0.257	0.316
Social factor	0.171	0.206	0.248
Public health policies	0.149	0.209	0.279
The rumour spread by media	0.107	0.156	0.221
Perception of vaccine	0.114	0.174	0.253

The non-fuzzy weight was defuzzified and normalised as in the sixth step. As a result, the fuzzy weight for the criterion “Previous Experience" was defuzzified as shown in Equation (10).

$$M=[(0.217+0.257+0.316)/3]= 0.63 \quad (10)$$

Finally, the normalised weight for the “Previous Experience" factor obtained as Equation (11).

$$N = [0.263/(0.228+0.241+0.263+0.209+0.213+0.161+0.181)] = 0.176 \quad (11)$$

Lastly, Normalized weight for all factors was calculated and the result shown in Table 7. By following the seven steps provided, the criterion with the highest score was suggested as the most essential factor.

Table 7. De-fuzzified and Normalized Fuzzy Weight.

Factor	De-fuzzified weight	Normalized fuzzy weight
Education	0.2281	0.152
Knowledge	0.2411	0.161
Previous experience	0.2632	0.176
Social factor	0.2089	0.139
Public health policies	0.2128	0.142
The rumour spread by media	0.1618	0.108
Perception of vaccine	0.1808	0.120

Based on Table 8, it can be observed that the Previous Experience was the main factor in refusal of the Covid-19 vaccine. This was proved by the factor's weight value, where this factor has the high value at 0.176. While other factor's weight value of education was 0.152, public health policies was 0.142, the social aspect was 0.139, knowledge was 0.161, perception of the vaccine was 0.121, and the rumour spread by media was 0.108. In comparison to the other factors, the factor of previous experience had the largest contributing value as at the first rank, becomes the top influencing criterion. It is followed by the second, third, fifth, sixth, and seventh, respectively, named knowledge, education, public health policies, social factor, perception of vaccines, and the rumours spread by media.

Table 8. Normalized Weights and Factor Ranking for COVID-19 Vaccines Refusal.

Factor	*N*	Rank
Previous experience	0.176	1
Knowledge	0.161	2
Education	0.152	3
Public health policies	0.142	4
Social factor	0.139	5
Perception of vaccine	0.121	6
The rumour spread by media	0.108	7

In addition, the result of factors influencing the refusal of the COVID-19 vaccine indicates the contrary existence between the result from the FAHP method and correlation analysis by SPSS. FAHP method showed that the primary factor was the previous experience. In contrast, correlation analysis showed that vaccine safety and effectiveness had the highest correlation influencing the refusal of the COVID-19 vaccine.

4. Conclusion

This study comprehensively evaluated and investigated the correlation factors that affect vaccine rejection for COVID-19. According to the Pearson correlation, the impression of vaccine safety and efficacy was the key factor influencing the refusal of the COVID-19 vaccine.

The social factor, the rumours spread by the media, education, previous experience, knowledge, public health policies, and other factors are placed after it. The relative weight of the primary element was determined by rank using the FAHP approach. Based on the technique, the key finding was that prior experience ranked highest. Knowledge, education, public health policies, social factors, perception of vaccines, and the rumour spread by media came next.

In addition, the FAHP approach also offers a solution for determining what element has the greatest impact on people's decisions to refuse COVID-19 immunizations. With the use of a correlation analysis, it was possible to identify the elements that were almost directly associated with vaccine refusal. Therefore, all objectives to be met have been successfully achieved. Furthermore, this study accepts the suggested criteria, omitting government and community views, that may influence a person's decision to refuse the COVID-19 vaccines. Thus, it is a factor that should be taken into consideration.

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Author Contribution

Author 1 contributed to the introduction, literature review, methodology, data analysis, and findings. Author 2 contributed to the methodology, data analysis, and findings. Author 3 refined the literature review, findings, implications, and conclusion.

Conflict of Interest

The authors have no conflicts of interest to declare.

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