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ORIGINAL

Navigating Parental Vaccine Hesitancy in Pahang, Malaysia: Insights into Childhood Vaccination Decisions

Abordaje de la reticencia parental a las vacunas en Pahang, Malasia: Perspectivas sobre las decisiones de vacunación infantil

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ABSTRACT

Introduction: vaccine hesitancy among parents is on the rise, with some opting for alternative vaccination schedules, selectively vaccinating their children, or rejecting vaccines altogether. Malaysia has reported 1600 cases of parents refusing to vaccinate their children, an increase from 1500 cases in 2015, with Pahang being one of the states experiencing the highest number of vaccine refusals.
Method: a quantitative approach was employed, utilizing surveys to collect and analyze data from 333 parents who have at least one child under the age of 16 in Pahang, Malaysia.
Results: the findings revealed that attitude and risk perception negatively influenced vaccine hesitancy, while other factors, such as subjective norms, perceived behavioral control, and safety perception, positively influenced childhood vaccine intention and negatively influenced vaccine hesitancy.
Conclusions: these results have important implications for public health initiatives aimed at reducing vaccine hesitancy in Malaysia. Understanding the factors that contribute to parents' decisions can help design targeted interventions that address misconceptions, improve risk perception, and encourage positive attitudes toward vaccination.

Keywords: Childhood Vaccine; Immunization; PLS-SEM; Theory of Planned Behavior; Global Vaccine Hesitancy.

RESUMEN

Introducción: la vacilación ante las vacunas entre los padres va en aumento, y algunos optan por calendarios de vacunación alternativos, vacunan selectivamente a sus hijos o rechazan completamente las vacunas. Malasia ha reportado 1600 casos de padres que se niegan a vacunar a sus hijos, un aumento respecto a los 1500 casos registrados en 2015, siendo Pahang uno de los estados con el mayor número de rechazos a la vacunación.
Método: se utilizó un enfoque cuantitativo mediante encuestas para recopilar y analizar datos de 333 padres con al menos un hijo menor de 16 años en Pahang, Malasia.
Resultados: los hallazgos revelaron que la actitud y la percepción del riesgo influyeron negativamente en la renuencia a la vacunación, mientras que otros factores, como las normas subjetivas, el control conductual percibido y la percepción de seguridad, influyeron positivamente en la intención de vacunar a los niños y

negativamente en la renuencia a la vacunación.
Conclusiones: estos resultados tienen importantes implicaciones para las iniciativas de salud pública dirigidas a reducir la vacilación ante las vacunas en Malasia. Comprender los factores que influyen en las decisiones de los padres puede ayudar a diseñar intervenciones específicas que aborden conceptos erróneos, mejoren la percepción del riesgo y fomenten actitudes positivas hacia la vacunación.

Palabras clave: Vacuna Infantil; Inmunización; PLS-SEM; Teoría del Comportamiento Planificado; Vacilación Global ante las Vacunas.

INTRODUCTION

Immunization is a paramount public health accomplishment, safeguarding individuals of all ages from severe diseases and preserving millions of lives annually. Vaccine hesitancy is a growing public health concern, as it undermines efforts to achieve optimal vaccination coverage necessary for controlling preventable diseases. While often associated with childhood immunization, vaccination spans the entire lifespan and includes critical interventions during pandemics. Quinn et al.[1] characterized vaccine hesitancy as negative vaccination intentions and actions. The national coverage of recommended childhood vaccinations remains stable; yet, several parents postpone or forgo immunizations. Global vaccination coverage decreased to 83 % in 2020 from 86 % in 2019, resulting in 23 million children under one year of age remaining unvaccinated for essential vaccines.[2]

Notwithstanding Malaysia's elevated immunization rate, vaccine hesitancy persists as a significant concern. Unvaccinated children experience a significantly elevated mortality rate [3] and vaccine hesitancy obstructs the management of vaccine-preventable diseases. Pahang saw numerous school and preschool outbreaks in 2019. Mat Daud[4] observed that Pahang's measles incidence has been stagnant since 2004, notwithstanding the implementation of the country's Measles Elimination Program. The incidence of vaccine refusals in Malaysia increased from 1500 in 2015 to 1600 in 2017, with Pahang exhibiting the highest percentage.[5]

This emerging trend underlines the urgent need to investigate Pahang parents' childhood vaccination hesitation. Identifying what causes vaccination refusal or hesitancy is crucial to increasing vaccine uptake and minimizing vaccine-preventable diseases.[3,6] Most vaccination reluctance studies were in developed countries.[7,8,9] Research on developing, low- and middle-income nations is scarce.[10] Thus, this study examines the factors influencing vaccine hesitation among Pahang parents, focusing on attitude towards childhood vaccine (ATT), subjective norm (SN), perceived behavioral control (PBC), risk perceptions (RP), and safety perception. The study examines how these factors, along with controlling variables like gender and age, affect vaccine reluctance and identifies critical predictors that may influence public health initiatives to reduce hesitancy and increase childhood vaccine uptake.

TPB was proposed by Icek Ajzen as a successor to the Theory of Reasoned Action.[11] Previous studies have employed the TPB to understand COVID-19 vaccination intentions.[12,13,14,15,16,17] Although TPB has been shown to explain vaccination behavior, it has limitations. The TPB claimed that human activities are the product of rational cognitive decisions, ignoring emotive factors like safety and danger perceptions.[18,19] For more utility, the TPB framework is updated with new constructs.[20] Adding risk and safety perception to the study model improves its prediction ability and better captures the emotional and subjective aspects that impact vaccine hesitation. The study approach recognizes that people's vaccination decisions are influenced by safety, perceived risks, and faith in the immunization process. This larger view improves targeted strategies that address cognitive and emotional influences on vaccination behavior by providing a more complete understanding of vaccine reluctance.

Attitudes toward Childhood Vaccination and Vaccine Hesitancy

Attitudes refer to an individual's assessment of the favorableness of an action, including its necessity, benefit, and effectiveness.[21,22] Past studies [23,24] found that having a negative attitude towards the influenza vaccine was a major barrier to vaccine uptake. Individuals who have negative attitudes towards vaccination showed lower vaccine uptake in every risk group.[25,26] Hossain et al.[27] found that respondents who had a more positive attitude toward the COVID-19 vaccine were less vaccine-hesitant. In other words, when parents have positive attitudes about childhood vaccines, they are less likely to be hesitant about vaccinating their children. As positive attitudes increase, vaccine hesitancy decreases. Therefore, the following hypothesis is derived: H1: Attitudes toward childhood vaccination have a negative influence on vaccine hesitancy.

Subjective Norms and Vaccine Hesitancy

Subjective norms refer to a perception of social pressure to perform a behavior based on the opinions of others and how much value one places on others' opinions.[28] This construct may include family, friends, healthcare professionals, social media, and mainstream media.[21] Zulkifli et al.[29] studied parental COVID-19

vaccine hesitancy and found that parents with low subjective norms towards taking the COVID-19 vaccine had higher odds of being vaccine-hesitant compared to parents with high subjective norms, suggesting that a lack of support for vaccination increases hesitancy. Fisher et al.[30] also found that a lack of support for COVID-19 vaccination for children from other parents, family members, clergy, and others in one's community has been a major barrier to parental vaccine acceptance. Based on the sentence, the direction of the hypothesis would be positive. The finding suggests that a lack of support for COVID-19 vaccination from various community members is a barrier to parental vaccine acceptance, implying that less support leads to greater vaccine hesitancy or lower acceptance. Therefore, it can be postulated that: H2: Subjective norms have a negative influence on vaccine hesitancy.

Perceived Behavioral Control and Vaccine Hesitancy

Perceived behavioral control refers to an individual's perception of their capability of performing a given behavior. Past studies found that when parents perceive greater behavioral control over the registration for childhood vaccination, their vaccine acceptance increases, helping to reduce vaccine hesitancy.[20,32] Hilyard et al.[32] found that parents were 1,3 times more likely than others to get their children vaccinated for every standard deviation increase in self-efficacy. Hossain et al.[27] found that respondents who felt they had greater control over the COVID-19 vaccination registration process were more likely to accept the vaccine, leading to lower vaccine hesitancy. Therefore, it can be hypothesized that: H3: Perceived behavioral control has a negative influence on vaccine hesitancy.

Risk Perception and Vaccine Hesitancy

Risk perception refers to people's beliefs, attitudes, judgments, and emotions about threats and benefits, as well as cultural and social dispositions in a broader sense.[33] It describes the relevance of risk to the individuals, and it is a combination of susceptibility and severity of risk.[34] Wismans et al.[35] verified that the perceived risk of vaccines is negatively associated with vaccination intention. Moreover, Link[34] proved that risk perceptions can lead to more cautious behavior. Given that vaccine hesitancy involves attitudes and behaviors related to avoiding vaccination,[1] it can be deduced that as parents' perception of vaccine risk increases, their level of vaccine hesitancy will decrease. Thus, it is postulated that: H4: Perceived risk associated with childhood vaccination has a negative influence on vaccine hesitancy.

Safety Perception and Vaccine Hesitancy

Safety perception, a sense of security, is a tradeoff between activity rewards and risks.[36] Vaccine reluctance affects safety.[37,38] People generate conclusions based on existing vaccines in the lack of facts and experience about new vaccine safety.[39] Several studies demonstrate that vaccine safety perception affects vaccination attitudes and practice. Fadhel[40] showed that safety perception strongly influences vaccination adoption. Safety perception affects vaccine reluctance, a negative vaccination intention, and behavior.[41] Featherstone et al.[42] noted that many people have considerable worries about COVID-19 vaccine safety, causing vaccine reluctance. According to Syan et al. [43], vaccine safety perception increases vaccination likelihood, which reduces vaccine reluctance. Therefore, it is hypothesized that: H5: Safety perception has a negative influence on vaccine hesitancy.

METHOD

Research Design

This study employed a quantitative, cross-sectional design conducted in Pahang, Malaysia, over a period of three months, from July to September 2024.

Population and Sampling

The target population included parents with children aged below 16 years residing in Pahang. Due to the absence of a complete sampling frame, the study utilized a purposive sampling method to recruit eligible participants. Inclusion criteria were parents or legal guardians residing in Pahang, having at least one child under the age of 16, willingness to participate, and provide informed consent. Meanwhile, the exclusion criteria included parents not residing in Pahang, parents with no children under 16, and the inability to complete the questionnaire due to language or cognitive barriers. A minimum sample size of 92 was calculated based on power analysis using the guidelines by Gefen et al.[49], assuming a medium effect size, a significance level of p = 0,05, and 80 % power. A total of 333 valid responses were collected, surpassing the minimum requirement and ensuring sufficient statistical power for analysis.

Data Collection Procedure

Data were collected face-to-face using printed questionnaires administered by trained enumerators. Respondents were approached in public places such as community centers, health clinics, and schools across

various districts in Pahang to ensure representation. Participation was voluntary, and respondents were assured of confidentiality.

Instrument Development

This study utilized a questionnaire consisting of two sections: 1) capturing the demographic profile of the respondents and 2) measuring items related to six latent constructs. The measurement items for attitude towards childhood vaccination, subjective norm, perceived behavioral control, safety perception, risk perception, and vaccine hesitancy were adapted from the works of Hossain et al.[27], Patwary et al.[15], Ryan et al.[44], Sarathchandra et al.[45], Zhang et al.[46], Liu et al.[47], and Zhou et al.[48], respectively. For attitude toward childhood vaccination, the construct was measured using six negatively worded items on a five-point Likert scale (1 = Strongly Disagree, 2 = Disagree, 3 = Neither Agree nor Disagree, 4 = Agree, 5 = Strongly Agree). A higher average score on this scale indicates a more negative attitude toward childhood vaccines, and vice versa. The variables subjective norms, perceived behavioral control, risk perception, and safety perception were measured using positively worded items, where higher scores reflect stronger subjective norms, greater perceived behavioral control, and higher levels of risk and safety perception, respectively. Vaccine hesitancy was assessed using seven positively worded items on a seven-point Likert scale (1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Neither Agree nor Disagree, 5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree). Higher scores on this scale indicate lower levels of hesitancy and greater willingness to vaccinate children. Conversely, lower scores reflect greater vaccine hesitancy, characterized by stronger reluctance, resistance, or skepticism toward childhood vaccination.

Data Analysis Procedure

The collected data of the study were analyzed using SmartPLS[50], which is a VB-SEM (Variance-Based Structural Equation Modeling) technique. Following the approach suggested by Hair et al.[51], this study employed a two-stage analysis. Firstly, the measurement model was assessed to determine convergent validity and discriminant validity. Secondly, the structural model was tested using the bootstrapping method with a resampling technique of 10000 iterations.[51] This approach was chosen to evaluate the hypotheses formulated in the study.

Ethical Considerations

Ethical approval for the study was obtained from the Tunku Abdul Rahman University of Management and Technology (TAR UMT) Ethics Committee (EC Ref No.: TAR UMT/EC/2023/07/04). Participation was voluntary, and written informed consent was obtained from all respondents. Data confidentiality and anonymity were strictly maintained throughout the research process.

RESULTS

Demographic Profile of the Respondents

Ultimately, 333 completed questionnaires were returned, indicating that the sample size was sufficient for the study. The demographic profile of the respondents reveals a diverse range of characteristics across various variables. In terms of gender, the majority of respondents were female (60,7 %), while males made up 39,3 %. The age distribution showed that the highest proportion of respondents was aged 30-39 (47,5 %), with the lowest being in the 18-24 age group (5,4 %). Regarding monthly household income, the largest group fell within the RM 2560 - RM 5249 range (33,1 %), while the smallest group earned RM 11820 and above (9,6 %). The working sector data highlighted that the majority were employed in the public sector, specifically teachers (37 %), while the smallest proportion worked in the private sector (3,9 %). Finally, in terms of district representation, this study possesses a relatively equal distribution of respondents from various districts of Pahang.

Common Method Variance

This study used single-source data in which the exogenous and endogenous variables were answered by the same person simultaneously; hence, procedural and statistical methods were employed to overcome issues related to CMV.[52,53] Procedures were covered in the instrument development section. Table 1 shows that the R^2 change with and without the marker (MV) are less than 0,09 for the statistical approach MLMV. [54] Adding marker variables does not significantly affect R^2. This data supports the insubstantiality of CMV; hence, CMV was not a concern in this study.

Table 1. A Comparison of the R^2 value between the baseline model and marker marker-included model

	VH
R^2 without Marker Variable	0,865
R^2 with Marker Variable	0,865

Control Variables

Gender and age were used as control variables because they ggreatly affected vaccine hesitancy.[55] After including the control variables (gender and age), the correlations between the exogenous variables (ATT, SN, PBC, RP, and SP) and the endogenous variable (VH) remained statistically significant, while the correlations between gender (p = 0,196) and age (p = 0,113) and vaccination hesitancy were not.

Measurement Model

The measurement model has to satisfy convergent and discriminant validity criteria. If loading is 0,50 or higher,[51] average variance extracted (AVE) is 0,5, and composite reliability (CR) is 0,7, convergent validity is usually proven.[51] Convergent validity is not an issue in the study because the outer loading, AVE, and CR are higher than the threshold values, as shown in table 2.

Table 2. Convergent validity

Construct	Indicators	Outer Loading	CR	AVE
NA	NA1	0,929	0,987	0,926
	NA2	0,973		
	NA3	0,972		
	NA4	0,967		
	NA5	0,969		
	NA6	0,962		
SN	SN1	0,962	0,977	0,934
	SN2	0,973		
	SN3	0,965		
PBC	PBC1	1		1
RP	RP1	0,906	0,911	0,775
	RP2	0,787		
	RP3	0,940		
SP	SP1	0,960	0,976	0,910
	SP2	0,914		
	SP3	0,971		
	SP4	0,969		
VH	VH1	0,972	0,991	0,943
	VH2	0,972		
	VH3	0,973		
	VH4	0,974		
	VH5	0,948		
	VH6	0,981		
	VH7	0,980		

After convergent validity, the model's discriminant validity was examined. Heterotrait-monotrait (HTMT) values below 0,9 indicate discriminant validity. Table 3's results meet the HTMT requirement because all values were below 0,9. Thus, this study showed that the model matched construct and item discriminant validity requirements.

Table 3. Heterotrait-Monotrait (HTMT) Ratio for Discriminant Validity Assessment

	NA	PBC	RP	SN	SP	VH
NA						
PBC	0,833					
RP	0,719	0,588				
SN	0,765	0,863	0,568			
SP	0,796	0,832	0,599	0,828		
VH	0,833	0,892	0,647	0,871	0,877	

Structural Model

Following the measurement model assessment, a multicollinearity test was conducted to ensure the reliability of the model. A VIF value above 10 indicates multicollinearity concerns (Myers[56]; Kleinbaum et al.[57,58]; Kaps & Lamberson[59]). As all VIF values were below 10 (table 4), no collinearity issues were found. Bootstrapping analysis was conducted to evaluate the structural model. The results revealed that attitudes toward childhood vaccination were negatively associated with vaccine hesitancy (β = -0,122, p < 0,005), indicating that more positive attitudes were linked to lower hesitancy. Similarly, subjective norms showed a significant negative relationship with hesitancy (β = -0,218, p < 0,005), suggesting that perceived social support or pressure to vaccinate reduces hesitancy. In addition, perceived behavioral control emerged as a strong negative predictor of vaccine hesitancy (β = -0,338, p < 0,005), implying that parents who feel more confident and capable of vaccinating their children are less hesitant. Perceived risk was also significantly associated with hesitancy (β = -0,066, p < 0,005), where lower risk perception corresponded with lower hesitancy. Finally, safety perception showed a significant negative relationship with hesitancy (β = -0,279, p < 0,005), indicating that the more parents believe vaccines are safe, the less hesitant they are to vaccinate their children. The model's predictive power was evaluated using R^2, which indicates how well predictors explain variance in vaccine hesitancy. As per Chin[61], values above 0,1 are acceptable. This study reported an R^2 of 0,865 (86,5 %), showing strong predictive accuracy.[60]

Table 4. Path Coefficient

	Relationship	Beta	SE	t-value	p-value	f^2	VIF	LL	UL
H1	ATT→VH	-0,122	0,058	2,111	0,017	0,025	4,357	-0,237	-0,044
H2	SN→VH	0,218	0,048	4,540	0,000	0,086	4,094	0,139	0,296
H3	PBC→VH	0,338	0,061	5,565	0,000	0,153	5,512	0,237	0,436
H4	RP→VH	-0,066	0,025	2,635	0,004	0,017	1,888	-0,108	-0,025
H5	SP→VH	0,279	0,071	3,920	0,000	0,151	3,808	0,184	0,421
Control Variables									
Gender		-0,044	0,051	0,858	0,196	-	1,076	-0,130	0,040
Age		0,020	0,017	1,212	0,113	-	1,053	-0,007	0,048

DISCUSSION

The results of this study indicate that parents with more positive attitudes toward childhood vaccination are significantly less hesitant to vaccinate their children. The findings are similar to those of Sharif Nia et al.[62], who found that if parents have positive attitudes about vaccines, they are less likely to hesitate. In the context of parents in Pahang, Malaysia, positive attitudes toward childhood vaccination are likely to decrease vaccine hesitancy because these attitudes reflect greater trust and confidence in the effectiveness of vaccines. Parents with favorable views are more informed or influenced by reliable health information from local healthcare providers and community outreach programs, which are active in Pahang. This study also found that parents who perceive greater encouragement or approval from others are more likely to vaccinate their children and show less hesitancy. The finding strengthens the previous study by Li et al.[63] and Zulkifli et al.[29], who found similar results. Abd Rahman et al.[64] contended that when parents perceive vaccination as a widely accepted norm among their peers and social circles, they are more likely to agree and vaccinate their children. Furthermore, vaccination behavior can also be influenced by community norms, broader cultural norms, and values.

This study also reveals that parents who feel more in control and capable of vaccinating their children are less vaccine-hesitant. In other words, when parents feel enhanced control over the registration process for paediatric vaccinations, such as selecting the time, location, or method of registration, their propensity for vaccine acceptance rises, consequently diminishing vaccine hesitation. This finding is consistent with prior research carried out by Fan et al.[12], Li et al.[63], and Dou et al.[65], who found that parental impression of enhanced control over the vaccination process correlated favorably with heightened vaccine acceptance and diminished vaccine hesitation. Money is one of the types of resources that can be associated with perceived behavioral control.[66] Ridzuan et al.[67] highlighted that parents are willing to vaccinate their children and are less likely to be vaccine-hesitant because in Malaysia, most of the childhood vaccination is provided free of charge by the government. Osman et al.[68] contended that, in Kuantan, vaccinating their children may be simple and feasible because most healthcare centers or clinics have prepared this vaccine to be administered at their location. Hence, it is believed that parents in Pahang are less likely to vaccine vaccine-hesitant because they have the capacity in terms of money, time and accessibility of the vaccines.

This study also found that parents who perceive less risk associated with vaccinating their children are less hesitant to vaccinate them. This study's findings align with existing studies; parents who perceive less risk and

greater benefit associated with vaccination exhibit lower vaccine hesitancy toward childhood immunization.[69,70,71] When parents believe the vaccine might be risky, they are more likely to question whether the vaccine is necessary, and this can lead to vaccine hesitancy.[72] Hence, acknowledging the need for vaccines for safeguarding children's health enhances parental acceptance and reduces vaccine refusal or postponement.

Finally, the study found that parents who believe vaccines are safe are less hesitant to vaccinate their children. Martinelli et al.[73] identified a comparable correlation, suggesting that apprehensions regarding vaccination safety affect vaccine hesitation. Similarly, Wagner et al.[74] discovered that parental apprehensions over vaccination safety were significantly associated with their reluctance to immunize their children. A study by Liao et al.[75] in Hong Kong revealed perceived vaccination safety as a significant factor influencing parents' willingness to vaccinate their children against influenza. The studies corroborate the current research findings, indicating that persons who consider vaccines as safe are more inclined to accept immunization. Enhanced confidence in vaccination safety later results in diminished vaccine reluctance.

CONCLUSION

In sum, positive attitudes, strong social norms, confidence, and perceived safety are protective factors against vaccine hesitancy. This study greatly enhances the theoretical comprehension of vaccine hesitancy, especially within the context of a developing nation such as Malaysia, specifically in Pahang. This study presents empirical evidence that expands the applicability of current theoretical frameworks and gives fresh insights into the determinants of parental vaccine reluctance in Pahang, Malaysia. This study significantly extends the TPB by including risk perception and safety perception as essential factors influencing vaccine reluctance. This study also offers numerous practical insights to inform public health policies, intervention tactics, and community engagement initiatives aimed at mitigating vaccine hesitancy among parents in Pahang, Malaysia.

Maintaining elevated vaccination rates is crucial for averting disease outbreaks and safeguarding public health. A significant result is the necessity for focused public health programs to counteract adverse parental perceptions about immunization. Educational programs must emphasize the advantages of vaccines, rectify misconceptions, and exhibit cultural sensitivity. Healthcare providers must be prepared to advise reluctant parents using empirical evidence.

This study has certain limitations that may inform future research recommendations. This study was carried out among parents residing in Pahang, Malaysia, which limits the generalizability of the findings to the wider population of parents across the country. Therefore, future studies should collect data from different states in Malaysia to ensure broader representation and enhance the generalizability of the results at the national level. In addition, this study utilized a cross-sectional design; thus, it only captures parents' perceptions and behaviors at a single point in time. Future research could adopt a longitudinal approach to examine changes in vaccine attitudes and hesitancy over time, providing deeper insights into causal relationships and evolving trends.

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CONFLICT OF INTEREST

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