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Low influenza vaccination rate despite good knowledge on seasonal influenza and its vaccine among Malaysian urban dwellers: A cross-sectional study

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ABSTRACT

Objective: To assess knowledge levels regarding seasonal influenza and its vaccine among high-risk Malaysian urban dwellers and identify factors associated with both knowledge acquisition and vaccination behavior.

Methods: This is a cross-sectional study conducted between April-July 2024 in two urban communities in Malaysia. High-risk participants (n=390) including adults ≥65 years or aged 18+ with chronic illnesses, were recruited through convenience sampling from public areas. Knowledge was assessed using a validated 12-item questionnaire (Cronbach's α=0.977), categorized as good (7-12 points) or poor (0-6 points). Primary outcomes included knowledge scores, vaccination uptake rates, and associated demographic and clinical factors. Multivariate logistic regression identified independent predictors of good knowledge and vaccination behavior.

Results: A total of 390 respondents were included in this study The mean age of the respondents were (58.4±12.7) years, and the majority of them were aged 65 or above (113/390, 29.0%), males (212/390, 54.4%), and of Chinese ethnicity (363/390, 93.1%). Though 68.7% (268/390; 95% *CI* 63.9%-73.2%) demonstrated good influenza knowledge, only 12.1% (47/390; 95% *CI* 9.0%-15.8%) received annual vaccination. Independent predictors of good knowledge included female sex (a*OR* 1.65, 95% *CI* 1.04-2.62, *P*=0.034), tertiary education (a*OR* 8.76, 95% *CI* 2.79-27.51, *P*<0.001), diabetes (a*OR* 2.68, 95% *CI* 1.07-6.69, *P*=0.035), and vaccination history (a*OR* 1.89, 95% *CI* 1.09-3.28, *P*=0.024). Only 24.4% (95/390) respondents received physician vaccination recommendations. Social media constituted the primary information source (34.6% *vs.* 24.4% from physicians).

Conclusions: A substantial knowledge-behavior gap exists in influenza vaccination among high-risk Malaysian adults. Despite good knowledge levels, vaccination rates remain critically low, highlighting that knowledge alone is insufficient to drive vaccination behavior. Low physician recommendation rates represent a critical missed opportunity for prevention. Healthcare system interventions focusing on provider education, systematic vaccination recommendations, and evidence-based social media campaigns are essential to improve vaccination coverage in high-risk populations.

Summary

Question: What factors are associated with knowledge about seasonal influenza and its vaccine among high-risk Malaysian urban dwellers, and how does knowledge relate to vaccination behavior?

Findings: In this cross-sectional study of 390 high-risk participants, 68.7% had good knowledge about influenza, but only 12.1% received annual vaccination. Age <65 years, female sex, higher education, and diabetes were significantly associated with better knowledge, while only 24.4% received physician recommendations for vaccination.

Meaning: Despite good knowledge, vaccination rates remain low, suggesting that healthcare provider recommendations and targeted education campaigns are crucial for improving vaccination coverage among high-risk populations.

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KEYWORDS: Influenza; Influenza vaccination; Knowledge; Associated factors

1. Introduction

Influenza is common in Malaysia, with previous literature reporting up to 15% of patients presenting with symptoms of influenza-like-infection or severe acute respiratory infection[1-3]. Unlike other temperate countries, influenza infection is seen all-year-round with occasional epidemics in Malaysia[2]. This year-round transmission patern poses challenges for vaccination timing and public health planning.

High-risk patients (aged ≥65 years, or with chronic illnesses), may have more severe health effects of influenza, such as the need for hospitalization or intensive care admission, or even mortality within a year due to influenza and its complications[1,4,5]. The economic burden is equally substantial, with high-risk patients accounting for a disproportionate share of healthcare costs associated with influenza-related complication[6].

Even though influenza vaccination has been proven to be beneficial for high risk patients, such as reducing rates of hospitalization and cardiac-related mortality, the influenza vaccination coverage rate among Malaysians are still very low (below 15%), even among health care workers[7]. Even concerning, studies among Malaysian healthcare workers–who should serve as vaccination advocates–report meager coverage rates of only 51.4%, with 10% expressing doubts about vaccine safety[7-9].

The relationship between health knowledge and vaccination behaviour is complex and often paradoxical. While health literacy is generally considered a prerequisite for informed health decisions, numerous studies have documented significant knowledge-behaviour gaps in vaccination uptake[10]. This phenomenon suggests that knowledge alone is insufficient to drive vaccination behaviour, and that structural, social, and psychological factors play equally important roles in vaccination decisions[11]. Understanding the factors that influence vaccination knowledge and the pathways from knowledge to vaccination behaviour is crucial for developing effective public health interventions. The Health Belief Model and Theory of Planned Behaviour provide theoretical frameworks suggesting that perceived benefits, barriers, self-efficacy, and social norms are critical mediators between knowledge and behaviour[12,13].

Despite the documented low vaccination coverage in Malaysia, there is still a critical gap in understanding the knowledge levels regarding seasonal influenza and its vaccine among high-risk populations. Previous Malaysian studies have focused primarily on health care workers or general population awareness, with limited investigation of knowledge-specific factors among those at highest risk for severe influenza outcomes[7-9].

Furthermore, the sources of health information and their influence on vaccination decisions in the Malaysian context remain poorly characterized. With the increasing prominence of digital media and social networks in health communication, understanding information sources and their relationship to vaccination knowledge and behaviour is essential for designing targeted interventions.

This study aims to address these knowledge gaps by (1) determining the level of knowledge about seasonal influenza and its vaccine among high-risk Malaysian urban dwellers; (2) identifying sociodemographic and clinical factors associated with better knowledge; (3) examining the relationship between knowledge levels and vaccination behaviour; and (4) characterizing information sources and healthcare provider recommendation patterns in this population.

The findings will inform evidence-based strategies for improving influenza vaccination coverage among high-risk population in Malaysia and similar resource settings, contributing to broader global efforts to reduce the burden of vaccine preventable disease.

2. Methods

2.1. Study design

This was a cross-sectional study design conducted between April to July 2024 in Sungai Long and Bandar Mahkota Cheras areas, 2 urban areas located in the district of Cheras in Selangor. These are the inclusion criteria for the participants (1) all adults aged 65 and above; (2) all adults age 18 and above with one or more co-morbidities; (3) currently pregnant adults. Healthcare workers, and adults age less than 65 or do not have any comorbidities were excluded. Participants were considered residents if they have resided for at least three months in the sampling areas. Respondents were recruited *via* convenient sampling at public areas such as parks, markets, schools, and commercial areas. This study received ethical approval from the UTAR Scientific and Ethical Review Committee (U/SERC/78-297/2024) on 14 May 2024. Furthermore, an informed consent form was given to each participant with explanation prior data collection.

2.2. Data collection

A physical questionnaire was administered through face-to-face interview style by the investigators, and verbal translation in Mandarin, Cantonese, and Malay languages were done if required. All researchers have undergone discussions and practices to ensure translation into different language were appropriate and same among

all prior the data collection process. A pilot study was done earlier on 40 individuals, which accounted for slightly over the 10% of the final sample size, with a total Cronbach's alpha value of 0.977.

The questionnaire comprises a few sections. Section one includes the sociodemographic parameters of the respondents such as age, sex, ethnicity, education background, marital status and occupation. Section two includes the respondents' health and vaccination history, including presence of any comorbidities or previous history of vaccination. Section three tested the respondents' knowledge of influenza with 12 questions. Each question has 3 options (yes, no, or not sure) and the participant will earn 1 point for each correct answer whilst 0 points will be given for incorrect or unsure answers. 2 categories were further created, with 0–6 indicating poor knowledge, 7–12 indicating good knowledge.

2.3. Statistical analysis

Analysis were done using SPSS version 29.0 (IBM Corp., Armonk, NY, USA). All numerical data were shown in means with standard deviation (SD) whilst categorical data were shown in percentage. Univariate associations between sociodemographic factors and knowledge categories were assessed using *Chi*-square tests or Fisher's exact tests for categorical variables, and independent *t*-tests or ANOVA for continuous variables.

For multivariate analysis, binary logistic regression was performed using forward stepwise selection. Variables with $P<0.20$ in univariate analysis were included as potential predictors. Model fit was assessed using the Hosmer-Lemeshow goodness-of-fit test, and multicollinearity was evaluated using variance inflation factors (VIF<5). Results are presented as adjusted odds ratios (a*OR*) with 95% confidence intervals. Statistical significance was set a $P<0.05$ (two-tailed).

3. Results

3.1. Participant characteristics

A total of 390 respondents participated in this study. The mean age was (58.4±12.7) years, with 113/390 (29.0%) aged 65 or above and a majority were males (212/390, 54.4%). Most of our respondents were of Chinese ethnicity (363/390, 93.1%) as our sampling areas were urban areas consisting of a large majority of Chinese residents (Table 1).

Regarding education, 319/390 (81.8%) respondents had received at least secondary education and most of them were either self-employed (135/390, 34.6%) or retired (126/390, 32.3%). The commonest health problem reported among the respondents were were hypertension (170/390, 43.6%), followed by diabetes (43/390, 11.0%) and heart diseases (19/390, 4.9%). Approximately 29.5% of the respondents (115/390, 29.5%) had known someone who had been admitted for a severe lung infection.

Table 1. Socio-demographics, co-morbidities and influenza vaccination history of the respondents according to knowledge level [*n* (%)].

Sociodemographic factor	Total (*n*=390)	Good knowledge	Poor knowledge	*P* value
Age, years				
<65	277 (71.0)	200 (74.6)	77 (63.1)	0.022
≥65	113 (29.0)	68 (25.4)	45 (36.9)	
Sex				
Male	212 (54.4)	134 (50.0)	78 (63.9)	0.012
Female	178 (45.6)	134 (50.0)	44 (36.1)	
Ethnicity				
Malay	16 (4.1)	7 (2.6)	9 (7.4)	0.165
Chinese	363 (93.1)	254 (93.1)	109 (89.3)	
Indian	6 (1.5)	4 (1.5)	2 (1.6)	
Others	5 (1.5)	3 (1.1)	2 (1.6)	
Religion				
Muslim	19 (4.9)	8 (3.0)	11 (9.0)	0.139
Buddhist	297 (76.2)	206 (76.9)	91 (74.6)	
Christian	48 (12.3)	35 (13.1)	13 (10.7)	
Hindu	6 (1.5)	4 (1.5)	2 (1.6)	
Others	20 (5.1)	15 (5.6)	5 (4.1)	

Table 1 continues in next page.

Table 1. Continued.

Sociodemographic factor	Total (*n*=390)	Good knowledge	Poor knowledge	*P* value
Education level				
No formal education	9 (2.3)	0 (0.0)	9 (7.4)	<0.001
Primary	62 (15.9)	36 (13.4)	26 (21.3)	
Secondary	181 (46.4)	127 (47.4)	54 (44.3)	
Tertiary	138 (35.4)	105 (39.2)	33 (27.0)	
Occupation				
Self-employed	135 (34.6)	92 (34.3)	43 (35.2)	0.432
Retired	126 (32.3)	82 (30.6)	44 (36.1)	
Employee	108 (27.7)	76 (28.4)	32 (26.2)	
Student	9 (2.3)	8 (3.0)	1 (0.8)	
Unemployed	12 (3.1)	10 (3.7)	2 (1.6)	
Marital status				
Married	315 (80.8)	214 (79.9)	101 (82.8)	0.539
Single	63 (16.2)	47 (17.5)	16 (13.1)	
Divorced	6 (1.5)	4 (1.5)	2 (1.6)	
Widowed	6 (1.5)	3 (1.1)	3 (2.5)	
Comorbidities				
Hypertension				
Yes	170 (43.6)	119 (44.4)	51 (41.8)	0.631
No	220 (56.4)	149 (55.6)	71 (58.2)	
Diabetes				
Yes	43 (11.0)	37 (13.8)	6 (4.9)	0.009
No	347 (89.0)	231 (86.2)	116 (95.1)	
Heart disease				
Yes	19 (4.9)	13 (4.9)	6 (4.9)	0.977
No	371 (95.1)	255 (95.1)	116 (95.1)	
Chronic lung disease				
Yes	3 (0.8)	3 (0.8)	0 (0.0)	0.555
No	387 (99.2)	265 (98.9)	122 (100.0)	
Kidney disease				
Yes	2 (0.5)	2 (0.5)	0 (0.0)	0.569
No	388 (99.5)	266 (68.6)	122 (100.0)	
Cancer				
Yes	1 (0.3)	1 (0.4)	0 (0.0)	>0.050
No	389 (99.7)	267 (99.6)	122 (100.0)	
Influenza vaccination history				
Has anyone you know been hospitalised for a severe lung infection?				
Yes	115 (29.5)	81 (30.2)	34 (27.9)	0.720
No	275 (70.5)	187 (69.8)	88 (72.1)	
Have you heard of influenza?				
Yes	353 (90.5)	249 (92.9)		0.024
No	37 (9.5)	19 (7.1)		
Have you ever received influenza vaccination?				
Yes	92 (23.6)	75 (28.0)	17 (13.9)	0.001
No	298 (76.4)	193 (72.0)	105 (86.1)	
Have you been vaccinated annually?				
Yes	47 (12.1)	37 (13.8)	10 (8.2)	0.076
No	343 (87.9)	231 (86.2)	112 (91.8)	
Has your doctor recommended you for annual vaccination?				
Yes	95 (24.4)	75 (28.0)	20 (16.4)	0.015
No	295 (75.6)	193 (72.0)	102 (83.6)	

3.2. Influenza vaccination coverage and awareness

Only 47/390 (12.1%; 95% *CI* 9.0%-15.8%) of our respondents receive annual influenza vaccinations, while 298/390 respondents (76.4%) had never received influenza vaccination in their life time. Despite this low vaccination rate, 353/390 respondents (90.5%) had heard of influenza.

Regarding healthcare provider engagement, only 95/390 participants (24.4%) received recommendations form their doctors for annual influenza vaccination. When asked about future influenza vaccination intentions, 203/390 respondents (52.1%) indicated that they were not keen for vaccination.

3.3. Knowledge assessment

The mean knowledge score of our respondents were (7.42±2.29). Around 68.7% of our respondents (268/390; 95% *CI* 63.9%-73.2%) had good knowledge on influenza and its vaccine as shown in Table 2.

Table 2. Knowledge scores of the respondents (n=390).

Sociodemographic parameters	Knowledge score (mean±SD)	*P* value
Age, years		
<65	7.67±2.22	<0.001
≥65	6.84±2.36	
Sex		
Male	7.13±2.31	0.003
Female	7.78±2.23	
Ethnicity		
Malay	6.56±2.34	0.491
Chinese	7.47±2.27	
Indian	7.33±3.08	
Others	7.60±1.21	
Religion		
Muslim	6.53±2.20	0.436
Buddhist	7.45±2.31	
Christian	7.71±2.28	
Hindu	7.17±2.99	
Others	7.35±1.93	
Education level		
No formal education	4.78±1.39	<0.001
Primary	6.48±2.53	
Secondary	7.24±1.98	
Tertiary	8.28±2.27	
Occupation		
Self-employed	7.10±2.04	<0.001
Retired	7.15±2.38	
Employee	7.84±2.32	
Student	10.11±2.26	
Unemployed	8.33±1.97	
Marital status		
Married	7.33±2.277	0.194
Single	7.97±2.403	
Divorced	7.50±2.074	
Widowed	6.67±1.211	
Comorbidities		
Hypertension		
Yes	7.32±2.38	<0.001
No	7.51±2.24	
Diabetes		
Yes	7.98±1.64	0.016
No	7.36±2.35	
Heart disease		
Yes	7.79±2.62	0.481
No	7.41±2.27	
Chronic lung disease		
Yes	10.00±2.00	0.051
No	7.41±2.28	
Kidney disease		
Yes	9.50±0.71	0.200
No	7.42±2.29	
Influenza vaccination history		
Has anyone you know been hospitalised for a severe lung infection?		
Yes	7.79±2.18	0.043
No	7.28±2.32	
Have you heard of influenza		
Yes	7.55±2.21	0.005
No	6.30±2.76	
Have you ever received influenza vaccination?		
Yes	8.36±2.03	<0.001
No	7.14±2.29	
Have you been vaccinated annually?		
Yes	8.02±2.09	0.029
No	7.35±2.31	
Has your doctor recommended you for annual vaccination?		
Yes	8.03±1.95	0.003
No	7.23±2.36	

Analysis of individual knowledge components revealed varying levels of understanding (Figure 1). Our respondents were aware that if infected with influenza, high risk group are at higher risk of developing complications (322/390, 82.6%), that influenza is spread through the respiratory tract (312/390, 80.0%), and that getting an influenza vaccination does not exclude one totally from an influenza infection (306/390, 78.5%). On the contrary, 59.5% (232/390) of the respondents were unsure or wrongly believed that influenza vaccine will weaken the immune system thus increasing the risk of getting an influenza infection, 70.8% (276/390) were unsure or did not know that influenza vaccination should be received annually, and 77.9% (304/390) of them were unsure or believed that influenza vaccine can increase the risk of heart diseases (Figure 1).

3.4. Information sources

Aside from healthcare providers, the main source of information among our respondents were from social media (135/390, 34.6%), television (99/390, 25.4%), printed media (73/390, 18.8%). 13.0% participants (51/390) got information from family and 8.3% refused

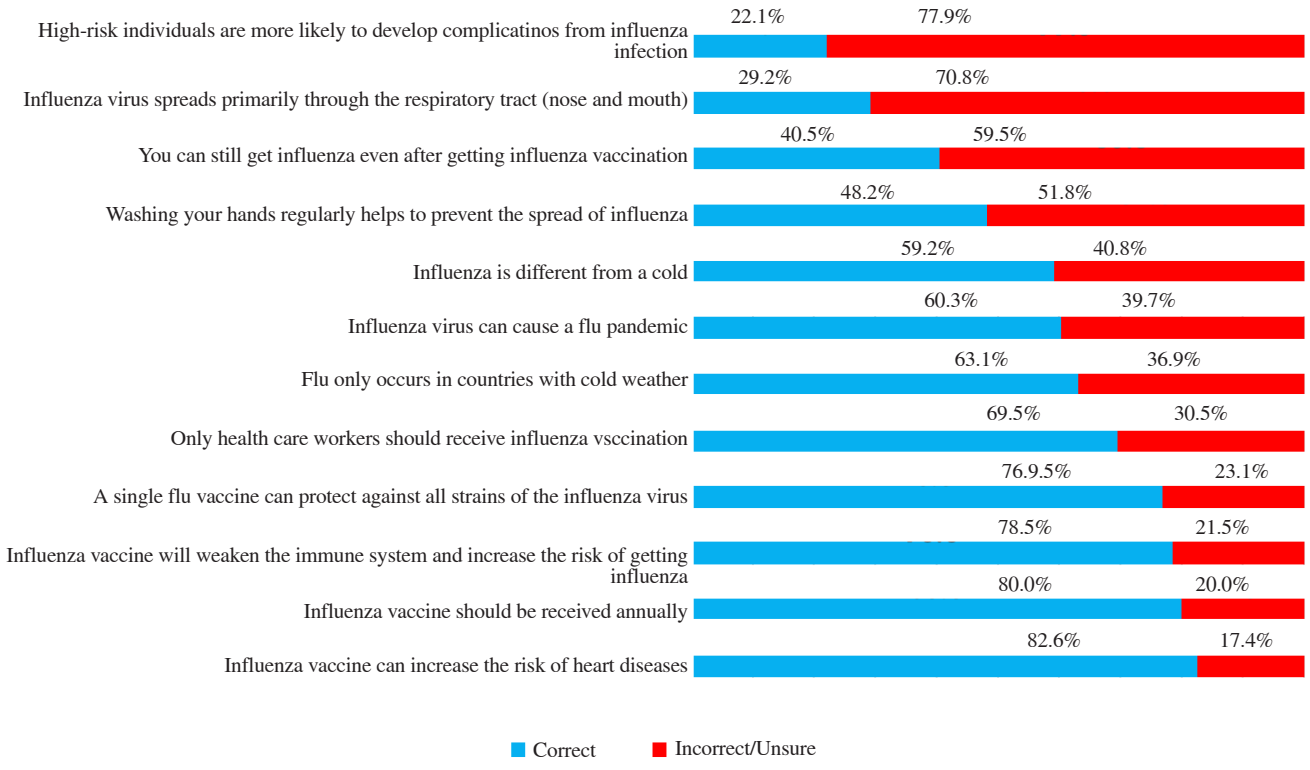

Figure 1. Bar chart showing the answers of the respondents on knowledge questions.

to disclose (32/390). Notably, healthcare providers ranked lower than social media and television, highlighting a significant gap in professional health communication.

3.5. Factors associated with knowledge levels

Chi-square analysis demonstrated significant associations between good knowledge levels and several demographic factors, *i.e.* age <65 years (*OR* 1.71, 95% *CI* 1.08-2.72, *P*=0.022), female sex (*OR* 1.78, 95% *CI* 1.13-2.79, *P*=0.012), education level (*P*<0.001) and background of diabetes (*OR* 3.11, 95% *CI* 1.27-7.58, *P*=0.009).

Respondents who had good knowledge were also likely to have heard of influenza (*OR* 2.29, 95% *CI* 1.11-4.74, *P*=0.024), have received vaccination before (*OR* 2.47, 95% *CI* 1.47-4.15, *P*=0.001), or have received recommendations from their doctors (*OR* 2.00, 95% *CI* 1.14-3.50, *P*=0.015) (Table 3).

When analyzing mean knowledge scores, respondents age<65 years (7.67±2.22 *vs.* 6.86±2.36, *P*<0.001), females (7.78±2.23 *vs.* 7.13±2.31, *P*=0.003), completed their tertiary education (8.28±1.64 *vs.*7.36±2.35, *P*=0.016) had significantly higher mean knowledge scores.

Binary logistic regression identified predictors of good knowledge (Table 3). After adjusting for confounding variables, female sex (a*OR* 1.65, 95% *CI* 1.04-2.62, *P*=0.034), diabetes (a*OR* 2.68, 95% *CI* 1.07-6.69, *P*=0.035), and history of vaccination (a*OR* 1.89, 95% *CI* 1.09-3.28, *P*=0.024) remained significantly associated with good knowledge.

Education level also demonstrated a strong "dose-response" relationship. Compared to no formal education, primary education (a*OR* 3.45, 95% *CI* 1.12-10.62, *P*=0.031), secondary education (a*OR* 4.89, 95% *CI* 1.58-15.12, *P*=0.006), and tertiary education (a*OR* 8.76, 95% *CI* 2.79-27.51, *P*<0.001) showed progressively stronger associations with good knowledge.

3.6. Vaccination behaviour and associated factors

Multivariate analysis identified four independent predictors of vaccination history, which are good knowledge (a*OR* 2.18, 95% *CI* 1.25-3.79, *P*=0.006), physician recommendation (a*OR* 3.24, 95% *CI* 1.92-5.47, *P*<0.001), tertiary education (a*OR* 1.87, 95% *CI* 1.09-3.21, *P*=0.023), and age ≥65 years (a*OR* 1.72, 95% *CI* 1.01-2.93, *P*=0.045) (Table 4).

For vaccine intention, three factors were significant predictors, namely physician recommendation (a*OR* 4.12, 95% *CI* 2.01-8.44, *P*<0.001), good knowledge (a*OR* 2.31, 95% *CI* 1.01-5.29, *P*=0.048), and tertiary education (a*OR* 2.45, 95% *CI* 1.15-5.22, *P*=0.020) (Table 4).

Table 3. Multiple logistic regression analysis for factors associated with good knowledge (*n*=390).

Variable	Crude *OR* (95% *CI*)	*P*-value	Adjusted *OR* (95% *CI*)	*P*-value
Age <65 years (ref: ≥65 years)	1.71 (1.08-2.72)	0.022	1.58 (0.98-2.56)	0.061
Female (ref: male)	1.78 (1.13-2.79)	0.012	1.65 (1.04-2.62)	0.034
Education level				
Primary education (ref: no formal education)	2.89 (1.01-8.29)	0.048	3.45 (1.12-10.62)	0.031
Secondary education (ref: no formal education)	4.12 (1.42-11.94)	0.009	4.89 (1.58-15.12)	0.006
Tertiary (ref: no formal education)	6.84 (2.33-20.12)	0.001	8.76 (2.79-27.51)	<0.001
Diabetes (ref: no diabetes)	3.11 (1.27-7.58)	0.009	2.68 (1.07-6.69)	0.035
Had history of vaccination (ref: no history of vaccination)	2.47 (1.47-4.15)	0.001	1.89 (1.09-3.28)	0.024

Model fit: Hosmer-Lemeshow χ^2=6.23, *P*=0.622; Nagelkerke R^2=0.168; Good knowledge indicates respondent score 7-12 marks in the knowledge questionnaire, whilst poor knowledge indicates score 0-6 marks.

Table 4. Multiple logistic regression analysis for factors associated with vaccination behaviour (*n*=390).

Variable	Adjusted *OR* (95% *CI*)	*P*-value
History of receiving vaccination		
Good knowledge (ref: poor knowledge)	2.18 (1.25-3.79)	0.006
Doctor recommendation (ref: no recommendation)	3.24 (1.92-5.47)	<0.001
Tertiary education (ref: no formal education)	1.87 (1.09-3.21)	0.023
Age ≥65 years (ref: <65 years)	1.72 (1.01-2.93)	0.045
Intention for annual vaccination		
Doctor recommendation (ref: no recommendation)	4.12 (2.01-8.44)	<0.001
Good knowledge (ref: poor knowledge)	2.31 (1.01-5.29)	0.048
Tertiary education (ref: no formal education)	2.45 (1.15-5.22)	0.020

Model fit (History of receiving vaccination): Hosmer-Lemeshow χ^2=8.91, *P*=0.349; Nagelkerke R^2=0.142; Model fit (Intention for annual vaccination): Hosmer-Lemeshow χ^2=5.44, *P*=0.709; Nagelkerke R^2=0.198.

4. Discussion

The main finding of this study, that 68.7% of our participants had good knowledge but only 12.1% received annual vaccination, represents a classic knowledge-behaviour gap that has been observed globally in vaccination research. This paradox suggests that knowledge alone is insufficient to drive vaccination behaviour, consistent with the Health Belief Model which emphasizes that perceived benefits, barriers, and cues to actions are equally important determinants of health behaviour[13].

Our findings align with similar studies from other developing countries where knowledge-behaviour gaps in vaccination have been documented[14-18]. For instance, studies in Thailand and Singapore have reported similar disparities, suggesting that structural and cultural factors may be more influential than individual knowledge in vaccination decisions[19-21].

Several barriers may explain the low vaccination uptake despite good knowledge, such as healthcare system barriers, accessibility and cost barriers, and finally cultural and social barriers. Only 2.4% of our participants received their physician's recommendations, indicating a critical gap in healthcare provider engagement. This is particularly concerning given that physician recommendations are among the strongest predictors of vaccination behaviour globally. The low recommendation rate may reflect limited awareness among healthcare providers about influenza vaccination guidelines or insufficient time during consultations to discuss preventive care. Family physicians or general practitioners are often the primary point of contact in the community and play an integral role in preventive medicine. Hence, they are the most important source of information and driving force to recommend and encourage patients for influenza vaccination. In other countries, doctors were also perceived as a trustworthy source of information compared to media[15,22].

However, vaccine hesitancy among healthcare workers may impede this, especially when healthcare workers are not aware of or not convinced with the benefits of influenza vaccine. A study in 2016 among Malaysian healthcare workers showed only 51.4% of 527 doctors were vaccinated and despite a significant proportion of them were aware of the possibility impact of influenza infection to their health, 10% of them were dubious of its safety profile[8].

While not directly measured in this study, accessibility and cost likely contribute to low uptake. Unless childhood immunizations, adult influenza vaccines are not universally free in Malaysia,

potentially creating financial barriers for high-risk individuals. The Malaysian Ministry of Health has recently announced free influenza vaccinations for high risk adults, especially those with cardiovascular diseases[23,24].

The predominance of social media (34.6%) over healthcare providers as main information sources suggests that vaccination decisions may be influenced by social networks and potentially unreliable information sources than professional medical advice. Social media and social networking services are now commonly used for information dissemination, replacing traditional media like television, radio and printed media. Social media is efficient and effective in its role to transmit and broadcast information; however, it is often be misused by those who advocate against vaccines to promote vaccine refusal or hesitancy in the community by spreading misinformation. Benis *et al.*[25,26] reported that social media use significantly influences the seasonal influenza vaccination compliance in their population, especially among younger urban dwellers. Nonetheless, if used appropriately and strategically managed, social media can be a powerful and efficient tool to increase the community's knowledge on influenza and its vaccine, encouraging more individuals to receive influenza vaccination[27-29].

Leading public health authorities have acknowledged annual influenza vaccination as an important preventive measure to reduce the mortality and morbidity from influenza infections, especially in the high risk groups. Malaysia's vaccination coverage (12.1%) falls significantly below World Health Organization recommendations of 75% for high-risk groups and trails neighbouring countries like South Korea (84.4%) and Thailand (20%)[7,20,21,30,31]. This disparity cannot be explained by knowledge levels alone, as our participants demonstrated comparable or higher knowledge than some international cohorts. This gap likely reflects differences in healthcare system organization, vaccine accessibility, and public health campaign effectiveness.

Countries with higher vaccination rates typically have well-established recommendation systems, better healthcare provider training, and more robust public health infrastructure for vaccine delivery[32,33]. Malaysia may benefit from adopting similar systematic approaches.

The clinical and public health implications of our studies are impactful. The finding that only 24.4% of high-risk individuals received vaccination recommendations represents a missed opportunity for primary prevention. Healthcare providers should systematically assess and proactively recommend influenza vaccination for all high-risk individuals during routine visits. This is particularly important for patients with diabetes, who showed higher knowledge levels but may benefit most from vaccination.

On the other hand, the reliance on social media for health information (34.6% *vs.* 24.4% physician recommendations) suggests the need for (1) enhanced healthcare provider education and reminder systems, (2) regulation and quality control of health information on social media platforms, and (3) targeted public health campaigns using social media channels to disseminate accurate information.

The low recommendation rates suggest systemic issue in preventive care delivery. Implementing electronic health reminders, provider incentives, and systemic vaccination protocols could significantly improve coverage rates[33-35].

Our research is not without limitations. This study was conducted in an urban area with predominantly Chinese participants (93.1%), limiting its generalizability to Malaysia's diverse population and rural areas where vaccination rates may be even lower. The cross sectional design also prevents establishing causal relationships between knowledge and vaccination behaviour. Longitudinal studies would better elucidate temporal relationships and behaviour change processes.

We did not include other important factors such as vaccine cost, accessibility, specific concerns about vaccine safety, and detailed healthcare provider interactions in our study. These factors may significantly influence vaccination decisions. Furthermore, the binary categorization of knowledge (good *vs.* poor) may oversimplify the complexity of health-related knowledge and its relationship to behaviour.

In conclusion, this study reveals a significant knowledge-behaviour gap in influenza vaccination among high-risk Malaysian urban dwellers. Despite 68.7% having good knowledge about influenza and its vaccine, only 12.1% received annual vaccination, indicating that knowledge alone is insufficient to drive vaccination behaviour.

The low rate of physician recommendations represents a critical missed opportunity to improve vaccination coverage. Healthcare providers must play a more proactive role in systematically recommending and facilitating influenza vaccination for high-risk patients. The predominance of social media as an information source highlights both challenges and opportunies. While social media can spread misinformation, it also represents a powerful platform for targeted, evidence-based health communication campaigns.

Addressing Malaysia's low influenza vaccination coverage requires a multi-pronged approach: (1) systematic healthcare provider education and reminder systems, (2) improved vaccine accessibility and affordability, (3) evidence-based social media campaigns, and (4) policy interventions to strengthen preventive care delivery systems.

Future research should focus on longitudinal studies to better understand vaccination decision-making processes and intervention studies to test strategies for bridging the knowledge-behaviour gap in vaccination.

Conflict of interest statment

The authors declare that they have no conflict of interest.

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Authors' contributions

KWH and LPP conceived the study, supervised data collection, and made critical revision of the manuscript. KTY, CCW, LJW, NPY and TYC contributed to data collection, data interpretation, performed statistical analysis, and drafted the manuscript. All authors approved the final version for publication.

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