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Original Research

Effectiveness of educational intervention on the knowledge, attitudes, and perceptions of community pharmacists regarding colorectal cancer screening in Klang Valley, Malaysia

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Abstract

Background: In Malaysia, a lack of awareness and negative perceptions of cancer screening have contributed to a delay in detecting colorectal cancer. Community pharmacists may play important roles in promoting colorectal cancer screening among the public. Previous research has shown that community pharmacists' participation in cancer screening is hindered by inadequate knowledge, highlighting the need for educational interventions. **Objectives:** This study aimed to assess the knowledge, attitudes, and perceptions (KAP) of community pharmacists regarding colorectal cancer screening. Additionally, it sought to evaluate the impact of an online educational intervention designed to improve their KAP. **Methods:** Fully registered community pharmacists working within the Klang Valley were recruited using convenience and snowball sampling methods. A 3-day online educational intervention was conducted in small intervention groups using a social media application. Post-intervention KAP levels were compared to baseline. **Results:** The study recruited 303 respondents. The baseline assessment revealed a "satisfactory" level of knowledge (medianpre=72.22%), "good" attitudes (medianpre=80.00%), and "satisfactory" perceptions (medianpre=60.00%). Following the intervention, all three variables showed statistically significant improvements to "good" knowledge (94.44%), "good" attitudes (80.00%), and "good" perceptions (80.00%). Male pharmacists were associated with a higher level of perception towards colorectal cancer screening. **Conclusion:** The online educational intervention significantly improved community pharmacists' KAP on colorectal cancer screening. The findings from this study underscore the potential of social media applications as a medium for educating community pharmacists to enhance their practice.

Keywords: Colorectal neoplasm; community pharmacist; health knowledge; educational intervention

INTRODUCTION

Colorectal cancer is the second most common cancer in Malaysia. The disease burden of cancer (DALY) was estimated to be RM 30.73 billion, of which 11.56% was contributed by colorectal cancer, imposing a substantial healthcare burden on Malaysia's healthcare system[1] Colorectal cancer is highly preventable through the detection and removal of polyps, which can be achieved by active screening among the targeted population. However, 70% of colorectal cancer patients in Malaysia were at stage III and IV at the time of diagnosis, when the cancer has generally started to spread and invade other parts of the body. This has led to a lower 5-year relative survival rate[2]. Screening programs for cancer in the targeted population have shown effectiveness in detecting malignancies or precancerous polyps early, allowing for timely diagnosis and reducing cancer rates[3]. Colorectal cancer screening takes advantage of the slow progression of polyps to adenomas and advanced adenomas, which can occur over 10 to 15 years. This provides a crucial opportunity for their removal before they become malignant[4,5]. Research suggests that using a biennial immunochemical faecal occult blood test (iFOBT), a stool-based test kit that detects blood in the stool, followed by a colonoscopy for positive iFOBT results, has led to a 70% reduction in stage IV colorectal cancer[6].

The Ministry of Health (MOH) Malaysia has developed a National Strategic Plan for Colorectal Cancer (NSPCRC) to address the disease burden of colorectal cancer. The plan recommends that asymptomatic individuals aged 50 to 75 undergo iFOBT every 2 years, followed by colonoscopy if necssary[2]. However, the National Health and Morbidity Survey 2019 reported that only 10.8% of individuals aged 50 and above have received iFOBT screening, indicating low colorectal screening participation[7]. Furthermore, a significant number of individuals with positive iFOBT results from screening campaigns did not follow up with colonoscopies[8]. A survey of adults aged 50 to 75 showed that 58% were willing to undergo colorectal screening[9] Multiple studies have highlighted the low awareness of colorectal cancer among the public in Malaysia[9–11]. To address this issue, healthcare professionals should take a more active role in increasing cancer screening rates[12,13].

Previous research has repeatedly demonstrated the benefits of involving healthcare professionals in efforts to increase cancer

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screening rates[12,13]. Community pharmacists, known for their easy accessibility, have emerged as key players in this initiative. As a result, governments in other countries have included community pharmacists in various national cancer screening programmes. For example, programmes such as Bowel Cancer UK and BowelScreen Australia have empowered community pharmacists to raise awareness about colorectal cancer screening and offer relevant consultations[14, 15].

In Malaysia, the National Strategic Plan for Cancer Control Programme 2021 - 2025 does not clearly outline the roles of community pharmacists in cancer screening, and community pharmacists' involvement is still limited[2]. There have also been reports of low public awareness of cancer screening and the underperformance of general practitioners in this area[16]. Recognising that patients are ten times more likely to visit community pharmacies than general practitioners, and the need to establish the roles of community pharmacists in cancer screening, it is crucial to assess their knowledge, attitudes, and perceptions (KAP) and implement interventions to enhance their capabilities, particularly in preparing them for future cancer screening programmes[17,18].

Currently, there are 4021 community pharmacies available across the country as of April 2023[17]. With this number expected to continue growing, community pharmacists are becoming even more easily accessible. As primary care providers, community pharmacists have the potential to play a key role in promoting colorectal cancer screening. Recognising that patients are ten times more likely to visit community pharmacies than general practitioners, expanding the roles of community pharmacists in cancer screening is essential[18,19]. To achieve this, it is crucial to assess their knowledge, attitudes, and perceptions (KAP) and implement targeted interventions to enhance their capabilities, particularly in preparing them for future cancer screening programs.

Due to the current lack of literature on Malaysian community pharmacists' knowledge, attitudes, and practices (KAP) towards colorectal cancer, the main objective of this research was to fill these gaps by assessing the KAP of community pharmacists in relation to colorectal cancer screening. Community pharmacists potentially play crucial roles in this area. Additionally, this study aimed to determine the impact of an online educational intervention in enhancing the KAP of community pharmacists regarding colorectal cancer screening within community pharmacy settings in Klang Valley, Malaysia.

MATERIALS AND METHODS

Study design, setting, and population

This educational intervention study was conducted among community pharmacists in the Klang Valley, Malaysia from April to June 2024. According to information from the Lembaga Farmasi Malaysia website, there were 1346 community pharmacy premises in the Klang Valley as of 27 October 2023. This suggests an estimated total of 1346 community pharmacists working in the Klang Valley, assuming each pharmacy is staffed by one pharmacist. Using Raosoft® version 2004, a sample size of 300 was calculated with a margin of error of 5%, confidence level of 95%, and response distribution of 50%. A 10% non-response rate was anticipated, resulting in a targeted final population of 330 for the study. Provisionally registered pharmacists and pharmacist assistants were not included in the study. Convenience and snowball sampling methods were utilized, and eligible community pharmacists were informed of the study through posters, email, social media, and in-person interactions.

Study instrument

The study instrument was an online Google Form divided into two sections. The first section gathered sociodemographic data with 9 questions, while the second section assessed community pharmacists' KAP on colorectal cancer screening with 30 questions. The knowledge questions were developed based on the information and recommendations outlined in the Clinical Practice Guidelines (CPG) for the Management of Colorectal Carcinoma[19]. Response options were "True", "False", and "I do not know". Correct answers received one point, while incorrect answers or "I do not know" received zero points. Attitudes (5 questions) and perceptions (7 questions) used Likert-scale responses as follows: Strongly disagree=1; Disagree=2; Neutral=3; Agree=4; Strongly agree=5. The questions assessing perception were adapted from Kerrison *et al.*, (2022)[20].

All questions were set as mandatory to prevent missing data. Experts from the faculty reviewed and validated the questionnaire. The survey instrument was created in English, assuming that all community pharmacists had English literacy skills. The survey took approximately 15 to 20 minutes to complete. Before the actual survey, a pilot study was conducted with 30 community pharmacists to evaluate the internal consistency of the questionnaire. The average Cronbach alpha value for the entire instrument was 0.817, with 0.705 for the knowledge section, 0.939 for the attitudes section, and 0.807 for the perceptions section.

Intervention and follow-up activities

Following the pre-intervention assessment, participants were grouped on WhatsApp® for the delivery of educational materials. A total of 3-day online educational intervention was conducted. On the first day, a brief video introducing colorectal cancer screening was shared. This was followed by three posters reinforcing information on colorectal cancer screening guidelines, signs and symptoms, risk factors for colorectal cancer, and screening modalities on the subsequent days. All educational materials were designed by the research team based on relevant literature and sourced from the websites of reputable organisations such as the WHO, the Centres for Disease Control and Prevention, the MOH Malaysia, and other non-governmental organisations[19,21,22]. They were examined by experts and necessary amendments were made. During the intervention period, the research team engaged the participants using polls and addressed inquiries. On the fourth day, the questionnaire was redistributed to assess participants' KAP after the educational intervention, with reminders to

complete the survey weekly for three consecutive weeks. The data collection concluded on the 30th day. Participants who completed the post-intervention questionnaire were labelled as "respondents", while those who voluntarily left the intervention group or were unable to submit the post-intervention questionnaire were classified as dropouts and excluded from the statistical analysis.

Ethical considerations

The study received approval from the IMU University's, research and ethical committees [approval code: MPP 1-2024(02)]. Respondents were awarded seven CPD points by the Malaysian Pharmaceutical Society. Data collection was conducted anonymously, with random codes assigned to each participant to ensure confidentiality. Informed written consent was obtained prior to participation.

Statistical analysis

Statistical analysis was conducted using SPSS version 29. First, descriptive statistics and the Kolmogorov-Smirnov test were used to assess the study variables. Median and IQR were used as the data were non-parametric. According to Alshammari *et al.*, (2024), the scores were converted into percentages. Using Bloom's cut-off point, community pharmacists who scored ≥80% were categorised as having good knowledge, those who scored between 60% and 79% were considered to have satisfactory knowledge, while those with scores less than 60% were categorised as having poor knowledge[23]. The association between KAP levels and sociodemographic characteristics was assessed using Kruskal-Wallis tests, with Dunn's Bonferroni post hoc multiple comparison tests performed for differences. The proportional difference of correct answer or positive attitudes/perceptions was assessed using McNemar tests[24]. Wilcoxon-signed rank tests examined the difference in median scores for each question and the overall median scores for each section respectively. Then, the correlation of the three dependent variables was examined using Spearman's rank correlation coefficient and interpreted based on Dancey and Reidy's interpretation of correlation[25]. Lastly, Binary Logistic Regression was employed to investigate the relationship between improvements in KAP (with improvement and without improvement) and variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 335 community pharmacists submitted the pre-intervention questionnaire, resulting in a response rate of 90.44%, with 303 final respondents reported**.**

Sociodemographic characteristics of the respondents

The sociodemographic characteristics of the respondents are shown in Table 1. The median age of the respondents was 30 (IQR: 27 – 33) and the median years of experience was 4.0 (IQR: 2.0 – 7.5 years).

Associations between sociodemographic variables and baseline KAP level

Male pharmacists showed a higher level of perception towards colorectal cancer screening. No other significant differences were observed in the KAP levels across the other sociodemographic variables analysed and shown in Table 2.

Comparison of knowledge

McNemar tests indicated a significant increase in the proportion of respondents providing correct answers for all questions assessing community pharmacists' knowledge of colorectal cancer screening guidelines, except for questions related to advancing age and inflammatory bowel disease and shown in Table 3.

Comparison of attitudes

Table 4 shows that the majority of respondents, ranging from 79.21% to 93.73%, had positive baseline attitudes (strongly agree and agree) towards colorectal cancer screening. Respondents indicated a willingness to provide counselling, engage in cancer health promotion activities, educate customers on using the iFOBT kit, encourage customers to undergo screening, and refer customers with suspected signs and symptoms. The only question regarding the willingness of pharmacists to educate customers on conducting iFOBT tests showed a statistically significant increase in positive responses post-intervention. Table 5 shows the comparison between the medians and IQRs of each attitude-related question.

Comparison of perceptions

Respondents showed significantly improved perceptions following the intervention, as evidenced by higher post-intervention medians and a greater proportion of positive responses. Detailed results are shown in Table 6 and Table 7.

Effectiveness of the educational intervention

The median scores for all three dependent variables - knowledge, attitude and perception of colorectal cancer screening improved significantly after the online educational intervention. The pre-intervention survey revealed that the majority of respondents had a "satisfactory" level of cancer screening knowledge, with only 31.02% (n=94) possessing "good" knowledge base. Following the educational intervention, the knowledge level significantly improved, with the new median score reflecting "good". Correspondingly, the proportion of respondents with "good" knowledge increased to 86.47% (n=262). On the other hand, the median score for attitudes remained at 20, equivalent to 80.00% pre- and post-intervention, indicating "good" attitudes of respondents. The IQR of attitudes showed a slight positive shift, due to a higher number of respondents having more favourable attitudes. Respondents exhibited statistically significant improvements in perception. Pre-intervention, median perception scores were ranked as "satisfactory". Post-intervention, an increase of 33.33% was recorded, moving in to the "good" category. Similar to knowledge, a dramatic shift was observed in the distribution of perception levels. Respondents with "good" perceptions rose from 6.93% (n=21) to 54.13% (n=164), while those with "poor" perceptions declined from 42.24% (n=128) to 3.96% (n=12). Table 8 shows the median scores (IQR) of knowledge,

Table 1. Sociodemographic characteristics (N_{pre} = 335, N_{post} = 303).

Characteristics	Pre-intervention		Post-intervention	
	Number of participants n_{pre} (%)		Number of respondents n_{post} (%)	
Age (years)				
21 – 25	36	(10.75)	33	(10.89)
26 – 30	152	(45.37)	135	(44.55)
31 – 35	72	(21.49)	67	(21.78)
36 – 40	46	(13.73)	43	(14.19)
41 – 45	16	(4.78)	15	(4.95)
46 – 50	4	(1.19)	4	(1.32)
51 – 55	4	(1.19)	4	(1.32)
56 – 60	3	(0.90)	1	(0.33)
Above 60	2	(0.60)	1	(0.33)
Gender				
Male	106	(31.64)	95	(31.35)
Female	229	(68.36)	208	(68.65)
Ethnicity				
Malay	35	(10.45)	26	(8.58)
Chinese	276	(82.39)	254	(83.83)
Indian	21	(6.27)	20	(6.60)
Others	3	(0.90)	3	(0.99)
Highest Academic Qualification				
Bachelor	306	(91.34)	277	(91.42)
Master	28	(8.36)	25	(8.25)
Doctorate	1	(0.30)	1	(0.33)
Number of years working as a community pharmacist				
1 – 5	224	(66.87)	200	(66.01)
6 – 10	61	(18.21)	57	(18.81)
11 – 15	33	(9.85)	32	(10.56)
16 – 20	7	(2.09)	7	(2.31)
21 – 25	4	(1.19)	4	(1.32)
26 – 30	6	(1.79)	3	(0.99)
On average, how many clients do you serve in a day?				
<100	156	(46.57)	142	(46.86)
100-200	145	(43.28)	132	(43.56)
201-300	29	(8.66)	26	(8.58)
>300	5	(1.49)	3	(0.99)
Type of pharmacy				
Chain Pharmacy	277	(82.69)	252	(83.17)
Independent Pharmacy	58	(17.31)	51	(16.83)
Role in pharmacy				
Owner	13	(3.88)	13	(4.29)
Franchised / Joint-Ventured	12	(3.58)	8	(2.64)
Manager	127	(37.91)	115	(37.95)
Full-time Pharmacist	131	(39.10)	120	(39.60)
Part-time retail pharmacist / Locum	52	(15.52)	47	(15.51)

Location of pharmacy				
Gombak	9	(2.69)	7	(2.31)
Hulu Langat	45	(13.43)	40	(13.20)
Klang	50	(14.93)	48	(15.84)
Kuala Langat	7	(2.09)	6	(1.98)
Petaling	90	(26.87)	79	(26.07)
Sepang	18	(5.37)	15	(4.95)
Wilayah Persekutuan Kuala Lumpur	104	(31.04)	97	(32.01)
Wilayah Persekutuan Putrajaya	12	(3.58)	11	(3.63)

Table 2. Associations between statistically significant difference sociodemographic variables with pre-intervention KAP levels (good, satisfactory, and poor).

Variables	**Mean rank**	**p-value**
Baseline colorectal cancer perception		
Male	167.22	0.022*
Female	145.05	

* A p-value of <0.05 indicates statistically significant.

Table 3. Comparison between the frequency of correct answers for each colorectal cancer screening knowledge question pre-intervention and post-intervention (n=303)

Item/ Question	**Correct answer**	**Pre-intervention**	**Post-intervention**	**χ^2**	**p-value**
		Frequency	**Frequency**		
		n_{post} (%)	**n_{pre} (%)**		
Part 2A: Knowledge of Colorectal Cancer Screening Guidelines					
Colorectal cancer screening should be offered to population aged 50 to 75 years.	TRUE	256 (84.49)	293 (96.70)	28.8	<0.001*
Carcinoembryonic antigen (CEA) test is a reliable serum test for colorectal cancer screening.	FALSE	45 (14.85)	216 (71.29)	161.45	<0.001*
Immunochemical faecal occult blood test (iFOBT) should be performed annually starting age of 50.	TRUE	163 (53.80)	281 (92.74)	102.16	<0.001*
Patients with a positive result of Immunochemical Faecal Occult Blood Test (iFOBT) should be referred for colonoscopy within 2 months.	FALSE	11 (3.63)	155 (51.16)	131.08	<0.001*
Patients with unexplained rectal bleeding, significant weight loss and unexplained iron deficiency anaemia should be referred for colonoscopy within 2 weeks.	TRUE	234 (77.23)	272 (89.77)	17.55	<0.001*
Part 2B: Knowledge in identifying risk factors for colorectal cancer					
Familial history of colorectal cancer	TRUE	290 (95.71)	300 (99.01)	-	0.021*
Smoking	TRUE	247 (81.52)	294 (99.01)	38.47	<0.001*
Overweight	TRUE	228 (75.25)	291 (96.04)	54.14	<0.001*
Inflammatory bowel disease	TRUE	282 (93.07)	293 (96.70)	3.7	0.054
Alcohol consumption	TRUE	263 (86.80)	296 (97.69)	23.81	<0.001*
Red meat consumption of more than 500 g per week	TRUE	195 (64.36)	284 (93.73)	78.22	<0.001*
Diabetes Mellitus	TRUE	175 (57.76)	265 (87.46)	67.13	<0.001*
Advancing age	TRUE	276 (91.09)	286 (94.39)	2.13	0.144
Part 2C: Knowledge in identifying signs and symptoms of colorectal cancer					
A repeated and painful urge to defecate without excreting stool (Tenesmus)	TRUE	262 (86.47)	295 (97.36)	22.76	<0.001*
Mucoid stool	TRUE	249 (82.18)	294 (97.03)	36.53	<0.001*

Weight gain	FALSE	169 (55.78)	229 (75.58)	31.65	<0.001*
Symptoms of anaemia	TRUE	250 (82.51)	295 (97.36)	36.53	<0.001*
Altered bowel habit	TRUE	286 (94.39)	301 (99.34)	-	<0.001*

* A p-value of <0.05 indicates statistically significant.
· Binomial distribution used for small number of discordant pairs.

Table 4. Comparison between the frequency of positively answered attitude-related questions towards colorectal cancer screening pre-intervention and post-intervention (n=303)

Item/ Question	Positive attitudes ("Strongly agree" or "agree")		χ^2	p-value
	Pre-intervention	Post-intervention		
	n (%)	n (%)		
I am willing to provide counselling to my patients/ customers regarding colorectal cancer screening.	262 (86.47)	275 (90.76)	2.82	0.093
I am willing to be involved in colorectal cancer health promotion activities.	245 (80.86)	255 (84.16)	1.19	0.275
I am willing to educate my customers on how to use immunochemical faecal occult blood tests.	240 (79.21)	260 (85.81)	6.02	0.014*
I am willing to encourage my customers who meet the screening criteria to undergo colorectal cancer screening.	273 (90.10)	282 (93.07)	1.64	0.2
I am willing to refer customers with suspected signs and symptoms of colorectal cancer to the hospital.	284 (93.73)	285 (94.06)	0	1

* A p-value of <0.05 indicates statistically significant.

Table 5. Comparison between median (IQR) for each colorectal cancer screening attitude item pre-intervention and post-intervention (n=303).

Item/ Question	Pre-intervention						Post-intervention						z	Mean rank (Negative)	Mean rank (positive)	Negative ranks (n)	Positive ranks (n)	p-value
	SD	D	N	A	SA	Median (IQR)	SD	D	N	A	SA	Median (IQR)						
	n (%)	n (%)	n (%)	n (%)	n (%)		n (%)	n (%)	n (%)	n (%)	n (%)							
Q1	12	3	26	167	95	4	14	1	13	156	119	4 (4-5)	2.36	66.7	53.18	48	80	0.018*
	-3.96	-0.99	-8.58	-55.12	-31.35	(4-5)	-4.62	-0.33	-4.29	-51.49	-39.27							
Q2	9	1	48	169	76	4	12	2 (0.66)	34	154	101 (33.33)	4 (4-5)	2.03	72.81	70.62	57	85	0.042*
	-2.97	-0.33	-15.84	-55.78	-25.08	(4-5)	-3.96		-11.22	-50.83								
Q3	8 (2.64)	4 (1.32)	51 (16.83)	170 (56.11)	70 (23.10)	4 (4-4)	12 (3.96)	3 (0.99)	28 (11.22)	161 (50.83)	99 (33.33)	4 (4-5)	3	65.49	60.97	42	82	0.003*
Q4	9 (2.97)	1 (0.33)	20 (6.60)	174 (57.43)	99 (32.67)	4 (4-5)	11 (3.63)	1 (0.33)	9 (2.97)	152 (50.17)	130 (42.90)	4 (4-5)	2.43	62.82	59.16	44	76	0.015*
Q5	9 (2.97)	1 (0.33)	48 (15.84)	169 (55.78)	76 (25.08)	4 (4-5)	12 (3.96)	2 (0.66)	34 (11.22)	154 (50.83)	101 (33.33)	4 (4-5)	1.01	59.36	53.53	47	64	0.313

*A p-value of <0.05 indicates statistically significant. Abbreviations: SD, Strongly Disagree; D, Disagree; N, Neutral; A, Agree; SA, Strongly Agree; Q1: I am willing to provide counselling to my patients/ customers regarding colorectal cancer screening; Q2: I am willing to be involved in colorectal cancer health promotion activities; Q3: I am willing to educate my customers on how to use immunochemical faecal occult blood tests; Q4: I am willing to encourage my customers who meet the screening criteria to undergo colorectal cancer screening; Q5: I am willing to refer customers with suspected signs and symptoms of colorectal cancer to the hospital.

Table 6. Comparison of the frequency of positive perceptions of colorectal cancer screening pre-intervention and post-intervention (n=303).

Item/ Question	Positive perceptions ("Strongly agree" or "agree")		?²	p-value
	Pre-intervention n (%)	Post-intervention n (%)		
I feel there is enough training about how to talk to patients/ customers about colorectal cancer screening in general.	39 (12.87)	185 (61.06)	125.15	<0.001*
I feel there is enough training about how to spot potential signs and symptoms of colorectal cancer.	40 (13.20)	204 (67.33)	144.4	<0.001*
I feel confident in making appropriate referrals for potential signs and symptoms of colorectal cancer.	72 (23.76)	233 (76.90)	146.29	<0.001*
I feel I have the knowledge to spot potential signs and symptoms of colorectal cancer.	73 (24.09)	241 (79.54)	148.35	<0.001*
I feel I have the time to discuss colorectal cancer screening, as well as the signs and symptoms of colorectal cancer with my patients.	105 (34.65)	232 (76.57)	79.89	<0.001*
It's part of my role to spot potential signs and symptoms of colorectal cancer.	232 (76.57)	272 (89.77)	23.77	<0.001*
I believe I can positively influence my patients' colorectal cancer outcomes.	228 (75.25)	265 (87.46)	17.28	<0.001*

*A p-value of <0.05 indicates statistically significant.

Table 7. Comparison between median (IQR) for each colorectal cancer screening perception related-question pre-intervention and post-intervention (n=303).

Item/ Question	Pre-intervention						Post-intervention						Z	Mean rank (Negative)	Mean rank (Positive)	Negative ranks (n)	Positive ranks (n)	p-value
	SD n (%)	D n (%)	N n (%)	A n (%)	SA n (%)	Median (IQR)	SD n (%)	D n (%)	N n (%)	A n (%)	SA n (%)	Median (IQR)						
Q1	49 (16.17)	145 (47.85)	70 (23.10)	28 (9.24)	11 (3.63)	2 (2-3)	7 (2.31)	44 (14.52)	67 (22.11)	139 (45.87)	46 (15.18)	4 (3-4)	12.01	98.31	119.44	16	219	<0.001*
Q2	38 (12.54)	138 (45.54)	87 (28.71)	31 (10.23)	9 (2.97)	2 (2-3)	7 (2.31)	35 (11.55)	57 (18.81)	152 (50.17)	52 (17.16)	4 (3-4)	12.07	88.70	126.92	22	224	<0.001*
Q3	25 (8.25)	87 (28.71)	119 (39.27)	59 (19.47)	13 (4.29)	3 (2-3)	2 (0.66)	9 (2.97)	59 (19.47)	177 (58.42)	56 (18.48)	4 (4-4)	12.15	63.23	109.38	11	202	<0.001*
Q4	22 (7.26)	102 (33.66)	106 (34.98)	64 (21.12)	9 (2.97)	3 (2-3)	2 (0.66)	6 (1.98)	54 (17.82)	178 (58.75)	63 (20.79)	4 (4-4)	12.80	56.00	119.29	12	219	<0.001*
Q5	6 (1.98)	70 (23.10)	122 (40.26)	89 (29.37)	16 (5.28)	3 (2-4)	2 (0.66)	3 (0.99)	13 (4.29)	76 (25.08)	156 (51.49)	4 (3-4)	9.96	85.83	99.71	24	171	<0.001*
Q6	3 (0.99)	10 (3.30)	58 (19.14)	185 (61.06)	47 (18.15)	4 (4-4)	2 (0.66)	3 (0.99)	26 (8.58)	194 (64.03)	78 (25.74)	4 (4-5)	5.31	62.13	73.29	41	98	<0.001*
Q7	2 (0.66)	4 (1.32)	69 (22.77)	185 (61.06)	43 (14.19)	4 (4-4)	2 (0.66)	2 (0.66)	34 (11.22)	190 (62.71)	75 (24.75)	4 (4-4)	5.06	64.21	68.80	38	96	<0.001*

* A p-value of <0.05 indicates statistically significant. Abbreviations: SD, Strongly Disagree; D, Disagree; N, Neutral; A, Agree; SA, Strongly Agree; Q1, I feel there is enough training about how to talk to patients/ customers about colorectal cancer screening in general; Q2, I feel there is enough training about how to spot potential signs and symptoms of colorectal cancer; Q3, I feel confident in making appropriate referrals for potential signs and symptoms of colorectal cancer; Q4, I feel I have the knowledge to spot potential signs and symptoms of colorectal cancer; Q5, I feel I have the time to discuss colorectal cancer screening, as well as the signs and symptoms of colorectal cancer with my patients; Q6, It's part of my role to spot potential signs and symptoms of colorectal cancer; Q7, I believe I can positively influence my patients' colorectal cancer outcomes.

Table 8. Effectiveness of educational intervention towards the KAP of colorectal cancer screening by median scores (IQR) (n=303).

	Pre-intervention median (IQR)		Post-intervention median (IQR)		Z	Mean Rank		N (n)	P(n)	p-value
	Score	Percentage (%)	Score	Percentage (%)		N	P			
Colorectal cancer screening										
Knowledge	13	72.22	17	94.44	13.78	48.21	145.69	19	258	<0.001*
	(11-15)	(61.11-83.33)	(15-18)	(83.33-100.00)						
Attitude	20	80	20	80	3.46	99.9	106.48	78	129	<0.001*
	(20-23)	(80.00-92.00)	(20-25)	(80.00-100.00)						
Perception	21	60	28	80	13.59	57.3	150.72	25	259	<0.001*
	(18-24)	(51.43-68.57)	(24-29)	(68.57-82.86)						

* A p-value of <0.05 indicates statistically significant. Abbreviations: N, negative ranks; P, positive ranks.

attitudes and perceptions variables, while Table 9 shows the proportions of respondents categorised using Bloom's cut-off point.

Correlation between dependent variable pairs

The Spearman's rank correlation coefficient for the dependent variables: knowledge, attitude, and perception scores for colorectal cancer screening is shown in Table 10.

Factors contributing to improved knowledge, attitudes, and perceptions

No predictor was found to be associated with a higher likelihood of improved attitudes and perceptions in this study.

DISCUSSION

This study's results are consistent with previous research highlighting a widespread deficiency in community pharmacists' knowledge of colorectal cancer screening[26–29]. This deficit may be due to the lack of comprehensive training programmes offered by relevant organisations and the absence of dedicated cancer screening education in pharmacy curricula. Notably, only a small percentage of respondents in this study reported receiving adequate training pre-intervention, which mirrors the findings of Uygun *et al*., (2023) who found that 90% of pharmacists in Istanbul lacked cancer screening training[30]. Hence, there is an urgent need for CPD programmes that equip pharmacists with updated knowledge and skills to effectively promote cancer screening practices.

The statistically significant improvement in knowledge scores following this online educational intervention demonstrated its effectiveness in addressing the identified knowledge gap. Compared to the baseline, this study yielded a remarkable 179% increase in knowledge median scores. These findings resonate with the growing number of research demonstrating the positive impact of educational interventions in improving participants' knowledge and practices related to cancer screening[30–32]. This highlights the necessities of similar educational interventions to empower community pharmacists for cancer screening education and counselling.

The study did not find any significant association between other sociodemographic characteristics with their baseline knowledge regarding cancer screening. These results suggested that baseline knowledge scores may not be directly influenced by sociodemographic factors. Gender difference, which was observed in colorectal cancer screening related perception, might be attributed to cultural and social factors. Males may have higher perceptions of colorectal cancer screening due to its higher incidence among men[33-35]. However, logistic regression did not find any association between sociodemographic characteristics with improved KAP. This is noteworthy because it implies that a uniform intervention to improve cancer screening knowledge among community pharmacists should be implemented regardless of their sociodemographic background, with a focus on ensuring equal accessibility for all.

A significant finding concerns a misconception among Malaysian community pharmacists, with 85% of respondents incorrectly believing that CEA is a recommended serum screening test for colorectal cancer. This finding aligns with a similar study conducted in Jordan by Alqudah *et al.* in 2021, where 90.3% of pharmacists held the same misconception.[24]. In contrast, a study conducted among primary care physicians in Kuala Lumpur, Malaysia, revealed a significantly higher understanding of the role of CEA[14]. This disparity in knowledge levels between community pharmacists and physicians suggests a potential gap in the education and training provided to community pharmacists with regards to diagnostic tools for cancer screening. While community pharmacists frequently engage in preventive healthcare, targeted educational interventions are essential to equip them with knowledge about diagnostic tests for colorectal cancer[15].

Moreover, while most community pharmacists in this study demonstrated a generally good understanding of colorectal cancer risk factors, approximately 40% of respondents failed to recognize excessive red meat consumption and diabetes mellitus as key risk factors. This percentage is particularly concerning given the high prevalence of these conditions in Malaysia. As the leading beef consumer in ASEAN, Malaysia presents a significant opportunity for community pharmacists to encourage the public to reduce red meat intake[36]. Additionally, with 19% of the Malaysian population affected by diabetes, it is imperative that community pharmacists recognise its link to colorectal cancer risk to effectively counsel patients on lifestyle modification[34]. Encouragingly, the current intervention significantly improved community pharmacists' recognition of red meat consumption and diabetes as risk factors, with the majority correctly identifying them post-intervention.

The pre-intervention survey revealed that more than 80% of respondents accurately identified the common signs and symptoms of colorectal cancer, such as tenesmus, mucoid stool, symptoms of anaemia, and altered bowel habits. This performance exceeded that of community pharmacists in Qassim, Saudi Arabia, where only 50% to 70% correctly identified these signs and symptoms[23,37]. While it is commendable that over 97% of respondents answered correctly post-intervention, a specific area for improvement was identified. Approximately 45% of respondents initially misidentified weight gain as a sign of colorectal cancer, and this misconception persisted at 25% even after the intervention. However, the research team speculated that this discrepancy might be attributed to acquiescence bias, as all responses regarding risk factors and signs and symptoms were "true", while weight gain was the only "false" answer[38].

Although the present study demonstrated a statistically significant improvement in overall attitudes scores, the magnitude of this improvement was minimal due to the high baseline attitudes. This suggests that most community pharmacists already held favourable attitudes towards colorectal cancer screening. However, despite these positive attitudes, there may be limitations in resources and confidence to effectively perform screenings, as evident with the moderate perception levels prior to the educational intervention. This

Table 9. Effectiveness of educational intervention towards the KAP of colorectal cancer screening by scores category using Bloom's cut-off point (n=303).

	Knowledge								Attitudes							
	Pre-	Post-	Z	Mean Rank		N	P	p-value	Pre-	Post-	Z	Mean Rank		N	P	p-value
	n (%)	n (%)		N	P	(n)	(n)		n (%)	n (%)		N	P	(n)	(n)	
Good	94 (31.02)	262 (86.47)	11.92	75.5	100.26	10	187	<0.001*	231 (76.24)	252 (83.17)	1.49	44.62	37.32	29	50	0.137
Satisfactory	149 (49.17)	38 (12.54)							60 (19.80)	37 (12.21)						
Poor	60 (19.80)	3							12 (3.96)	14 (4.62)						
		-0.99														

	Perceptions							
	Pre-	Post-	Z	Mean Rank		N	P	p-value
	n (%)	n (%)		N	P	(n)	(n)	
Good	21 (6.93)	164 (54.13)	12.9	82	110.4	7	211	<0.001*
Satisfactory	154 (50.83)	127 (41.91)						
Poor	128 (42.24)	12 (3.96)						

* A p-value of <0.05 indicates statistically significant. Abbreviations: Pre-, pre-intervention; Post-, post-intervention; N, negative ranks; P, positive ranks.

Table 10. Correlation between KAP scores for colorectal cancer screening (n=303).

Type of cancer	Variable pair for scores	Pre-intervention		Post-intervention	
		Spearman's rho (r_s)	p-value	Spearman's rho (r_s)	p-value
Colorectal cancer screening	Knowledge vs. attitude	0.109	0.058	0.217	<0.001*
	Knowledge vs. perception	0.159	0.005*	0.268	<0.001*
	Attitude vs. perception	0.242	<0.001*	0.531	<0.001*

* A p-value of <0.05 indicates statistically significant.

finding is consistent with a study conducted in Jordan.[28] Given these high positive attitudes, organisation should consider drafting a plan to incorporate colorectal cancer screening services into community pharmacists' daily practice.

Similar to the knowledge level, there was a positive shift from "satisfactory" to "good" in perception levels after this educational intervention, highlighting its effectiveness. Specifically, before the intervention, only about 10% of respondents felt they had sufficient training for colorectal cancer screening. This finding is consistent with a study by Urbanek *et al*., (2024), where only 18.7% of community pharmacists perceived they had adequate training for colorectal cancer screening[39]. Additionally, in this study, fewer than 25% of respondents felt confident in making appropriate referrals and recognising potential signs and symptoms pre-intervention. With this educational intervention, this percentage increased to over 70%, indicating that enhanced training and knowledge significantly boost confidence, potentially leading to improved practice[40].

Although the positive perception for each individual question increased significantly, a considerable number of community pharmacists, ranging from 10.12% to 38.94%, still failed to achieve positive perceptions post-intervention. To further enhance community pharmacists' perception and practices, physical workshops should be considered to enhance their ability to initiate conversations with patients regarding cancer screening. This is particularly crucial because cancer screening requires cultural sensitivity, as many people are reluctant to discuss such topics openly[41]. Additionally, by increasing community pharmacists' confidence in spotting signs and symptoms and making appropriate referrals, they can be better prepared to provide cancer screening services to their customers[40]. Another notable improvement was observed in the question regarding having sufficient time

to discuss cancer screening with customers. COM-B model, which stands for Capability, Opportunity, Motivation, and Behavior, is a comprehensive framework for behavioral transformation created by Michie *et al*. It is commonly used in health behavior research and intervention design, serving as the foundation of the Behavior Change Wheel (BCW). This finding reflects the physical opportunity component of the COM-B model, as proposed by Michie *et al*. According to this model, providing knowledge and educational materials can reduce perceived time management barriers, thereby creating more opportunities for community pharmacists to engage in cancer screening activities[17]. Lastly, the approximately 13% increase in the final two perception questions indicates that more community pharmacists are now motivated to take on the responsibility of promoting cancer screening. Their belief in their ability to positively influence patients' cancer outcomes further fuels this motivation[20,40].

To raise awareness of cancer screening and enhance the effectiveness of cancer screening initiatives in the future, educational interventions should be implemented for healthcare providers. They can then share their knowledge with the general public[42]. Potential interventions, such as educational materials and training, were suggested by Beshir *et al.*, (2012), as potential means of encouraging community pharmacists to participate in cancer screening campaigns[42]. In line with this recommendation, this current study utilised a social media application as a platform to deliver educational materials in the form of short videos and posters to enhance the capabilities of community pharmacists and motivate them to participate in cancer screening initiatives.

Online education, also known as e-learning, has long been recognised as a cost-effective method for delivering education. Online educational allows participants to study at their own pace, review materials at any time and from anywhere convenient for them, as long as they have mobile phones. Online learning is particularly well-suited for working adults, as it offers autonomy in pursuing their areas of interest[43]. Despite its many benefits, online learning can present challenges, such as varying levels of familiarity with technology among participants[44]. Ensuring accessibility and effective use of digital platforms is crucial for maximizing the impact of online educational interventions. For instance, Mensah *et al*., (2022) demonstrated the effectiveness of using a social media platform for educational purposes through a 30-minute voice-over audio PowerPoint presentation. They highlighted the broad reach and engagement potential of these platforms[30]. This study utilised WhatsApp®, a widely used social media application in Malaysia, to address accessibility concerns and ensure that the intervention reached a broad audience[45].

The bivariate correlation analysis revealed a weak positive correlation between knowledge and attitudes, as well as between knowledge and perceptions post-intervention. This finding is consistent with Puspitasari *et al*., (2020), who also reported a weak correlation between knowledge and attitudes among university students. This study highlights that knowledge may not be the sole determinant of attitudes[46]. Additionally, the present study also noted a significant, albeit weak, correlation between attitudes and perceptions pre-intervention, which strengthened to a moderate correlation post-intervention. This result is consistent with that of Puspitasari *et al*[47]. Several previous studies have explained the correlations between knowledge and attitudes or perceptions. For example, Sendall *et al.*, (2018) found that community pharmacists in Australia with better knowledge exhibited greater confidence in performing cancer screenings[47]. Similarly, Kerrison *et al*., (2022) emphasized that psychological factors, such as attitudes and perceptions, are closely linked to pharmacists' behaviours in promoting cancer screening. These findings suggest that enhancing knowledge through educational interventions could have a positive impact on pharmacists' practice[20].

A significant challenge in promoting colorectal cancer screening in Malaysia is the lack of a structured framework to involve community pharmacists in the national cancer screening programme[48]. This gap hinders accurate measurement of their practice. Developing and implementing structured frameworks for involving community pharmacists in colorectal cancer screening initiatives is important, as these pharmacists can serve as valuable and cost-effective resources[12,49]. The Malaysian government should draw upon international examples to guide the integration of community pharmacists into screening programmes. For instance, in Singapore, community pharmacies serve as distribution hubs for free iFOBT kits to eligible individuals[50]. Additionally, in the UK and Australia, programmes such as Bowel Cancer UK and BowelScreen Australia empower community pharmacists to raise awareness about colorectal cancer screening and offer relevant consultations[14,51].

Community pharmacists could serve as the initial point of contact for the public regarding educational intervention, cancer screening, and early detection[49]. Previous pharmacist-led programmes have achieved high participation rates[12,50-52]. Therefore, community pharmacists are well-positioned to provide educational resources, such as brochures and videos, along with personalized counselling, to help address and correct public misconceptions about cancer[49]. The educational materials designed for community pharmacists in this study can be adapted to meet the needs of the public, thereby expanding the public's knowledge and understanding of cancer screening.

However, it is important to note that this study did not include a control group for comparing pre- and post-intervention results. This decision was based on a literature review that showed most community pharmacists had insufficient knowledge of colorectal cancer screening[26,28,29]. Therefore, administering the intervention to all participants was deemed necessary to enhance their expertise and achieve the desired outcomes. However, the lack of a control group presents a challenge in attributing the changes in KAP solely to the educational intervention. The observed improvements could be influenced by external factors, personal experiences, or the effects of taking the pre-test[53]. Additionally, this study was limited to the Klang Valley and did not include community pharmacists from rural areas. To enhance the generalizability of the findings,

future initiatives should expand to other regions of the country and recruit a more diverse group of community pharmacists.

Another limitation was that the study did not impose a specific deadline for completing the post-intervention questionnaire, and the impact of the time lapse on KAP results was not analysed. Given the online nature of the study and the demanding schedules of community pharmacists, setting a strict deadline could have resulted in inadequate response rates. Therefore, the research team opted for a one-month period for each intervention group to complete the post-intervention survey. Furthermore, the potential for self-reporting bias must be considered, as respondents might have assessed their own attitudes and perceptions subjectively. Finally, 80% of the data were collected using convenience sampling method, where community pharmacists who were willing to participate were approached physically. While this approach might have introduced selection bias, it was necessary due to the time constraints of completing the data collection within two months for a Master's degree research project, as random sampling would be more time-consuming[54-56].

CONCLUSION

The present study concluded that community pharmacists' baseline knowledge of colorectal cancer screening was satisfactory, their attitudes were good, and their perceptions were also satisfactory. This online educational intervention effectively addressed the gaps in KAP related to colorectal cancer screening among community pharmacists, leading to overall improvements in all three areas. Notably, most community pharmacists expressed a willingness to participate in colorectal cancer screening health promotion activities following the intervention. To enhance the practice of community pharmacists in colorectal cancer screening, the involvement of organisations and the government is necessary in designing more structured educational training programmes.

AUTHOR CONTRIBUTIONS

LSY: Conceptualization, Investigation, Data Curation, Writing – Original Draft, Writing – Review & Editing

PVI: Conceptualization, Methodology, Investigation, Writing – Review & Editing, Supervision, Project Administration

PLS: Conceptualization, Methodology, Investigation, Data Curation, Writing – Review & Editing, Supervision, Project Administration

CONFLICT OF INTEREST

All authors have read and approved the final manuscript. Authors do not have any conflict of interest.

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ETHICAL STATEMENT

The proposal, with Project ID: MPP1-2024(02), was approved by the Joint Committee on Research and Ethics of IMU University (IMU-JC). The anonymity and confidentiality of the data were respected and maintained throughout the study.

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