Doi.org/10.36721/PJPS.2024.38.1.REG.015-024.1

Knowledge, attitude and practices of Saudi pharmacists regarding CVD risk factors and associated barriers

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Abstract: Risk assessment for cardiovascular diseases (CVD) is fundamental to prevention, enabling early intervention when risks are recognized. This cross-sectional study focuses on evaluating the knowledge, attitude, practices and perceived barriers of Saudi pharmacists regarding CVD risk factors. A self-administered survey was employed to collect the responses from the participants over a period of four months. Approximately 91% of the participants had completed their graduations and 49.4% of the participants had an experience of less than 5 years. Only 23.1% and 40.1% of the participants reported possessing functional sphygmomanometer and glucometer in their pharmacies, respectively, as a point of care tools. A high level of positive attitude was significantly (P=0.014) associating the level of education. The study identified several barriers influencing the CVD prevention services during pharmaceutical care. The top three barriers were lack of time (66.4%), lack of privacy (58.6%) and lack of tools (59.9%). Despite inadequate knowledge and barriers, a favourable attitude CVD prevention was observed. Thus, pharmacists' CVD risk assessment and preventive hurdles must be addressed. In addition to the Ministry of Health (MoH)'s recent public policy measures, healthcare workers should receive ongoing education and training on CVD prevention and treatment.

Keywords: Pharmacists, cardiovascular disease, knowledge, attitude, practice, barrier.

Submitted on 06-06-2024 – Revised on 25-10-2024 – Accepted on 31-10-2024

INTRODUCTION

Cardiovascular diseases (CVDs) are the leading causes of death and a major economic burden (World Health organization, 2024). Interestingly, by addressing the risk factors like hypertension, diabetes mellitus, dyslipidaemia, tobacco use, alcohol, unhealthy diet, and physical inactivity, the development of CVDs can be significantly prevented (Alhabib *et al*., 2020). The Saudi Health Council reported that the majority of the population have hypercholesterolemia (35-40%) and diabetes mellitus (12.3%) in common and growing remarkably (Saudi Health Council, 2022). It has been projected that that there will be an increase in CVDs in Saudi Arabia approximately 480,000 people by the year 2035, with a threefold increase in economic burden (USD 9.8 billion) (Gagnon-Arpin *et al*., 2018). Thus, it is crucial that we must promptly undertake a variety of interventions to contain the CVDs among this population. Risk assessment for CVDs is the cornerstone for disease prevention and can be assessed by using risk estimation algorithms (Australian Guideline for assessing and managing cardiovascular disease risk, 2023; Studziński *et al*., 2019). Various guidelines around the world mention the rationale and evidence for quantitative risk assessment, which provides practical advice regarding implementation of risk assessment and decision-making strategies in clinical practice (Samarasekera *et al*., 2023; Lloyd-Jones *et al.*, 2019). Notably, hypertension, diabetes mellitus, and dyslipidemia are considered as a major risk factor by various CVDs risk assessment guidelines either as independent risk factors or as a comorbidity closely associated with CVDs (Achila *et al*., 2022; Teo and Rafiq, 2021; Guembe *et al*., 2020). Pharmacists can play an active part in the risk evaluation and primary prevention of CVDs. Various systematic reviews and meta-analyses provides robust evidence supporting the impact of interventions of pharmacists in effectively reducing the risk factors associated with CVDs in clinical practice (Brown *et al.* 2016; Ifeanyi Chiazor *et al*., 2015; Alabkal *et al*., 2023; Martínez-Mardones *et al*., 2019). However, the involvement of pharmacists in the primary prevention of CVDs and related health promotion activities seems to be limited in Saudi Arabia and other Middle-east countries (Alavudeen *et al*., 2023; Almansour *et al*., 2020; Almansour *et al.*, 2021). Several obstacles have been reported that impede the active engagement of pharmacists in the prevention of CVDs. These hindrances encompass the issues related to pharmacists' knowledge, attitude and practices, time constraints, insufficient educational tools, lack of official recognition and communication issues (Alavudeen *et al*., 2023;

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Almansour *et al*., 2021; Sendekie *et al*., 2023; Wang *et al*., 2023). Knowledge, attitude and practices (KAP) is survey-based quantitative study that exposes disagreements and obstacles in implementing patient care strategies. It measures the extent of a current scenario and provides refractions of reality about various health-related issues concurrent to a well-matched intervention strategy for the respective population (Al-Ashwal *et al*., 2022; Andrade *et al*., 2020). Therefore, this study aimed to evaluate the KAP of Saudi pharmacists regarding risk assessment and tracing the barriers to curb it and provide best possible healthcare to society. Thus, our study aimed to assess the pharmacists' knowledge, attitude, practices, and perceived barriers regarding risk assessment of CVDs.

MATERIALS AND METHODS

Study design and setting

This cross-sectional study aimed to evaluate the differences in KAP among pharmacists with regards to the prevention of CVDs, specifically in relation to their practice settings. A self-administered survey was employed to collect the responses from the participants. A thorough literature review of previous studies regarding CVDs related knowledge, attitude and involvement in its prevention was conducted and a 34-item questionnaire was designed, developed, and validated using the field pre-test method. The pilot study data was analysed and internal consistency was calculated (Cronbach's alpha). The estimated Cronbach's alpha coefficient was found to be 0.83.

The questionnaire consisted of five sections, encompassing both open-ended and closed-ended questions. The first section of the questionnaire included thirteen items to gather demographic and clinical characteristics, including age, gender, nationality, educational qualification, years of experience, type of pharmacy, number of prescriptions a day, availability of functional sphygmomanometers, glucometers and CVD training. The second section consisted of seven questions to assess the participants involvement in CVDs related health promotion activities. The third section included seven questions to determine the attitude towards CVDs prevention and health promotion. Section four targeted the identification of the perceived barriers for providing CVDs prevention services. The last section assessed the knowledge of the diagnostic cut-offs for hypertension, diabetes, dyslipidemia and obesity.

Sample size calculation and participants

As per the year 2021 data, the reported number of registered pharmacists in the Asir region is around 1934 (Ministry of Health, Statistical Yearbook, 2021). Keeping the margin of error at 5%, confidence interval at 95%, response distribution 50% and attrition rate 5%, the required sample size was calculated as 321. Raosoft software was used for calculating the sample size (Raosoft software; Raosoft, Inc., 2007, Seattle, WA, United States).

Data collection

The study was conducted over a period of four months from December 2021 to March 2022 among practicing pharmacists in the city of Abha, Saudi Arabia. An online survey of the developed questionnaire was created using Google forms and the link was circulated to the participants via social media platforms including Facebook, Twitter, WhatsApp, etc. The first page of the questionnaire included the statement for informed consent explaining the nature of the study and participant's willingness to continue or not. If the individual wanted to continue, he would navigate to the other pages of the questionnaire and complete it.

STATISTICAL ANALYSIS

Data analysis was performed using the Statistical Package of Social Sciences Software, Version 25.0 (IBM, Armonk, NY, USA). Descriptive statistics were applied to the categorical variables and represented as frequency and percentages. All the categorical variables and the frequency distribution between the groups for various responses to KAP concurrent to the associated barriers were estimated using both parametric and non-parametric Chi-square test. However, multiple linear regression was used to analyse the factors (variables) affecting KAP concurrent to the associated barriers. A p-value of less than 0.05 was taken as the level of significance between groups.

Ethical approval

Ethical approval (Approval number-ECM#2020-1103) was granted by The Research Ethics Committee at King Khalid University (HAPO-06-B-001), Abha, Saudi Arabia. The ethical committee approved informed consent, and a questionnaire to conduct the study. The purpose of this study and the self-administered questionnaire was explained to the participants.

RESULTS

Total of 324 participants were included in the current study. 96% of the pharmacists were less than 40 years of age. Gender difference was major as indicated from data. Around 75% of the participants were male and 24.7% female. 62.7% of the participants were Saudi citizens followed by Egyptians (24.7%) and others. Importantly, around 64.5% of the participants completed their bachelor's degree followed by PharmD (26.5%). In terms of experience, 49.4% of the participants had an experience of less than 5 years, followed by 38.3%, who had 6-10 years of experience. Nearly half of the

Table 1: Demographic characteristics of the participants (pharmacists; n=324)

Variables	Categories	N (%)	P-Value
Age	≤ 30	197 (60.8)	0.000
	30 - 40	116 (35.8)	
	>40	11 (3.4)	
Gender	Male	244 (75.3)	0.000
	Female	80 (24.7)	
Nationality	Saudi	203 (62.7)	0.000
	Egyptian	80 (24.7)	
	Yemeni	18 (5.6)	
	Others	15 (2.5)	
Region	South	278 (85.8)	0.000
	Eastern	21 (6.5)	
	Others	25 (4)	
Educational Qualification	Diploma in Pharmacy	19 (5.9)	0.000
	Bachler in Pharmacy	209 (64.5)	
	Masters in Pharmacy	10 (3.1)	
	Doctor of Pharmacy	86 (26.5)	
Professional practice (In years)	≤ 5	160 (49.4)	0.000
	6 - 10	124 (38.3)	
	11 - 15	36 (11.1)	
	16 - 20	4 (1.2)	
Type of Pharmacy	Community pharmacy	157 (48.5)	0.000
	Government hospital pharmacy	92 (28.4)	
	Private hospital pharmacy	75 (23.1)	
Number of prescriptions per day	≤30	134 (41.4)	0.000
	31 - 50	96 (29.6)	
	51 - 100	37 (11.4)	
	101 - 200	34 (10.5)	
	>200	23 (7.1)	
Number of pharmacists in each shift	01	101 (31.2)	0.000
	>01	223 (68.8)	
Average number of prescriptions containing medications for CVD risks	≤ 10	130 (40.1)	0.000
	11 -20	98 (30.2)	
	21 - 30	40 (12.3)	
	> 30	56 (17.3)	
Availability of Sphygmomanometer	Yes	104 (32.1)	0.000
	No	220 (67.9)	
Availability of Glucometer	Yes	130 (40.1)	0.000
	No	194 (59.9)	
Completed CVDs training.	Yes	165 (50.93)	0.000
	No	159 (49.07)	
Interested in taking CVDs training program	Yes	240 (74.07)	0.000
	No	84 (25.93)	

participants (48.5%) were working in the community pharmacies, 28.4% in government hospitals, 23.1% in private hospitals. Total 94 (29.01%) participants reported that they used to receive between 50-200 prescriptions in a working day. Among the participants, 130 (40.1%) reported that they receive less than 10 prescriptions for CVDs per day, 30.2% and 29.6% between 11-20 and 21-30 prescriptions a day, respectively. 23.1% and 40.1% of the participants were possessing functional sphygmomanometer and glucometer in their pharmacy as a point of care tool for primary evaluation of risk for CVDs and associated diseases (table 1).

Table 2 depicts the level of KAP in different variables. Considering the knowledge, overall poor knowledge on cardiovascular diseases was evident among the participants (8%). At the same time, there was a significant difference among the participants interested in training (P=0.007). Moreover, none of the demographic characteristics are associated with the knowledge on cardiovascular diseases. In view of attitude, a high level of positive attitude was reported among the pharmacists (92%). Level of education (B.Pharm) was significantly (P=0.014) associated with the positive attitude of the pharmacists on CVDs management. The pharmacists working in community pharmacy (P=0.018), prescription transcribed and dispensed per day (P=0.006), number of prescriptions containing CVD medications (P=0.010), and glucometer availability (P=0.020) were having significant

Table 2: Knowledge, attitude and practice score of participants regarding the CVD risks.

Variables		Knowledge			Attitude			Practice		
		Poor	Good	*P* value	Negative	Positive	*P* value	Bad	Good	*P* value
Age	≤ 30	180	17	0.586	12	185	0.242	34	163	0.238
	30 - 40	107	9		12	104		12	104	
	>40	11	0		0	11		2	9	
Gender	Male	228	16	0.090	16	228	0.308	27	217	0.001
	Female	70	10		8	72		21	59	
Nationality	Saudi	183	20	0.080	14	189	0.771	35	168	0.010
	Egyptian	76	4		6	74		5	75	
	Yemeni	17	1		1	17		5	13	
	Others	22	2		3	20		5	20	
Region	South	256	22	0.227	20	258	0.443	38	240	0.067
	Eastern	17	4		3	18		7	14	
	Others	25	0		1	24		3	22	
Educational Qualification	Diploma in Pharmacy	19	0	0.235	1	18	0.014	4	15	0.666
	Bachler in Pharmacy	188	21		9	200		28	181	
	Masters in pharmacy	10	0		1	9		1	9	
	Doctor of Pharmacy	81	5		13	73		15	71	
Professional practice (In years)	≤5	144	16	0.592	7	153	0.133	30	130	0.205
	6 - 10	116	8		12	112		15	109	
	11 - 15	34	2		5	31		3	33	
	16 - 20	4	0		0	4		0	4	
Type of Pharmacy	Community pharmacy	148	9	0.135	5	152	0.018	16	141	0.075
	Government hospital pharmacy	85	7		10	82		18	74	
	Private hospital pharmacy	65	10		9	66		14	61	
Number of prescriptions per day	≤30	126	8	0.127	7	127	0.006	18	116	0.019
	31 - 50	90	6		15	81		11	85	
	51 - 100	30	7		1	36		7	30	
	101 - 200	31	3		1	33		11	23	
	>200	21	2		0	23		1	22	
Number of pharmacists in each shift	01	93	8	0.963	4	97	0.111	13	88	0.507
	>01	205	18		20	203		35	188	
Average number of prescriptions containing medications for CVDs risks	≤ 10	121	9	0.329	5	125	0.010	17	113	0.529
	11 -20	88	10		13	85		14	84	
	21 - 30	35	5		5	35		9	31	
	> 30	54	2		1	55		8	48	
Availability of Sphygmomanometer	Yes	98	6	0.304	7	97	0.749	11	93	0.140
	No	200	20		17	203		37	183	
Availability of Glucometer	Yes	177	17	0.550	9	185	0.020	27	167	0.579
	No	154	11		10	155		16	149	
Completed CVDs training	Yes	144	15	0.359	14	145	0.346	32	127	0.008
	No	215	25		20	220		29	211	
Interested in taking CVD training program	Yes	83	1	0.007	4	80	0.282	19	65	0.019
	No	298	26		24	300		48	276	

CVDs: Cardiovascular diseases; Parametric Chi square test was applied to measure the differences among the responses of participants; P-value ≤ 0.05 was considered significant.

high positive attitude for CVDs related risk prevention by pharmaceutical care. The good practice was reported among nearly 85% of pharmacists. Gender (Male; P=0.001), Nationality (Saudi; P=0.010), and prescription transcribed and dispensed per day (P=0.019) significantly impacted the practice of pharmacy in CVDs risk reduction. Interestingly, there was a significant difference among pharmacists (P=0.019) regarding interest in CVDs related training programs associated with pharmacy practice.

As depicted in table 3, among all barriers, lack of time (Barrier 1; 66.4%), lack of privacy (Barrier 2; 58.6%), and lack of tools (Barrier 4; 59.9%) were found to be the three top barriers impacting the CVDs management during pharmaceutical care.

Table 3: Different perceived barriers related to knowledge, attitude, and practice of cardiovascular diseases risks management and prevention

Perceived Barriers	Outcome	N (%)	P-Value
Barrier 1: Lack of time	Negative	109 (33.6)	0.000
	Positive	215 (66.4)	
Barrier 2: Lack of privacy/space, Difficulty in identifying targeted patients, Lack of personnel	Negative	134 (41.4)	0.000
	Positive	190 (58.6)	
Barrier 3: Lack of official recognition for health promotion activities, Lack of monetary benefits	Negative	204 (63)	0.000
	Positive	120 (37)	
Barrier 4: Lack of tools (educational materials, self-monitoring medical devices and/or no standard guideline available) and Lack of skills in using the tools	Negative	130 (40.1)	0.000
	Positive	194 (59.9)	
Barrier 5: Lack of therapeutic knowledge or skills in providing counseling, Lack of communication with other health care providers	Negative	181 (55.9)	0.000
	Positive	143 (44.1)	
Barrier 6: Language barrier	Negative	269 (83)	0.000
	Positive	55 (17)	

N: Number; %: Percentage; Chi square test was applied to measure the differences among the responses of participants; P-value ≤ 0.05 was considered significant.

Table 4 describes the impact of the top three barriers, lack of time (Barrier 1), lack of privacy (Barrier 2) and lack of tools (Barrier 4) on different variables. Among these barriers included in the analysis, barrier 1 (lack of time) was significantly associated with the number of prescriptions transcribed and dispensed per day (P=0.001) and average number of prescriptions containing medications for CVDs risks (P=0.008). Another barrier, barrier 4 (lack of privacy/space) assessed for its association with sociodemographic variables and reported statistically significant association with age of pharmacist (P=0.028), qualification of pharmacy degree (P=0.003) and average number of prescriptions containing medications for CVD risks (P=0.010).

However, we observed that educational qualification (P=0.020), number of pharmacists in each shift (P=0.020), number of prescriptions containing medications for CVDs risks (P=0.031), availability of Sphygmomanometer (P=0.045), availability of Glucometer (P=0.023), CVDs related training accomplished (P=0.046), and interested in CVDs related training program (P=0.001) was significantly allied with barrier 2 (lack of tools and lack of skills in using the tools).

Table 5 represents the multiple linear regression analysis showing relationship between different variables with factors affected that is knowledge, attitude, and practice of participants. Our data indicated that knowledge of pharmacists was not related to either variable (P>0.05). However, variables like gender (P=0.001), nationality (P=0.030), region (P=0.007), qualification (P=0.000), and CVDs related training received (P=0.001) were greatly associated to the attitude of practicing pharmacists. In terms of practice, variables such as gender (P=0.000), experience of practice (P=0.000), types of pharmacy (P=0.004), and pharmacists interested in CVDs related training (P=0.000) greatly impacted the practice of the pharmacists.

DISCUSSION

Over the past decades, the role of the pharmacist has been changed with high pace towards focussed health care provider instead of just medicine supplier or dispenser (Ministry of Health, 2021; Rasheed *et al*., 2023; Alhazmi *et al.,* 2023). The understanding of risk related to CVDs is considered to be of paramount importance (Saudi Health Council, 2022; CDC, 2023; Du and Qin, 2023). Understanding the risk factors that contribute to the development of CVDs is essential for the primary prevention. Undoubtedly, it is evident that pharmacists in Saudi Arabia have emerged as frontline healthcare provider to society, due to easy accessibility, ease of consultation, and affordability (Assiri *et al*., 2021; World Health Organization, 2019). Keeping this context in mind, the present study aimed to provide valuable insight into the knowledge, attitudes, and practice towards CVD risks, as well as the associated barriers.

Our data indicated the highest proportion of young age (96%), male (75.3%) pharmacists working in different pharmacy setups. Allowing female pharmacists to work in community settings facilitated women empowerment in the pharmacy sector to achieve the 2030 Vision that aimed to increase the participation of females in the job market. As reported previously, the average proportion of women working in the pharmacy profession increased significantly between 2016 and 2021 (Almaghaslah *et al*., 2023; Almaghaslah *et al*., 2021). Importantly, the majority (63%) of pharmacists were Saudi citizens among all. It means that Saudi pharmacists are overtaking the pharmacists' positions more efficiently as practicing pharmacists as before there was only 20% participation (Almaghaslah *et al*., 2023; Alrasheedy *et al*., 2022; AlRuthia *et al*., 2018). For better pharmacy practice, it is utmost important to have higher qualification. Similar to previous studies, we also observed that 94% of the pharmacists had qualifications either graduation or higher than graduation (Almaghaslah *et al*., 2023; Almaghaslah *et al*., 2021; Alrasheedy *et al*., 2022).

Table 4: Impact of perceived barriers related to knowledge, attitude and practice of cardiovascular diseases risks management and prevention on different variables

Variables		Barrier 1			Barrier 2			Barrier 4		
	Category	Negative	Positive	*P* value	Negative	Positive	*P* value	Negative	Positive	*P* value
Age	≤ 30	62	135	0.087	70	127	0.028	84	113	0.516
	30 - 40	40	76		58	58		42	74	
	>40	7	4		6	5		4	7	
Gender	Male	76	168	0.097	101	143	0.982	91	153	0.070
	Female	33	47		33	47		39	41	
Nationality	Saudi	67	136	0.882	81	122	0.240	88	115	0.589
	Egyptian	29	51		36	44		29	51	
	Yemeni	6	12		8	10		5	13	
	Others	7	16		9	14		8	15	
Region	South	93	185	0.129	122	156	0.127	115	163	0.090
	Eastern	6	15		4	17		3	18	
	Middle	6	7		3	10		5	8	
	Western	0	6		3	3		3	3	
	Northern	4	2		2	4		4	2	
Educational Qualification	Diploma in Pharmacy	7	12	0.541	12	7	0.003	11	8	0.020
	Bachler in Pharmacy	72	137		96	113		86	123	
	Masters in pharmacy	5	5		3	7		7	3	
	Doctor of Pharmacy	25	61		23	63		26	60	
Experience of practice (In years)	≤ 5	49	111	0.526	62	98	0.416	62	98	0.829
	6 - 10	43	81		52	72		53	71	
	11 - 15	15	21		17	19		13	23	
	16 - 20	2	2		3	1		2	2	
Type of Pharmacy	CP	53	104	0.778	68	89	0.053	62	95	0.059
	GHP	33	59		29	63		30	62	
	PHP	23	52		37	38		38	37	
Number of prescriptions/days	≤ 30	54	80	0.000	54	80	0.365	52	82	0.405
	31 - 50	16	80		36	60		36	60	
	51 - 100	20	17		21	16		13	24	
	101 - 200	9	25		14	20		16	18	
	> 200	10	13		9	14		13	10	
Number of pharmacists each shift	01	40	61	0.126	42	59	0.956	31	70	0.020
	> 1	69	154		92	131		99	124	
Average number of prescriptions containing medications for CVDs risks	≤10	52	78	0.008	61	69	0.010	54	76	0.031
	11 -20	22	76		30	68		31	67	
	21 - 30	19	21		23	17		14	26	
	> 30	16	40		20	36		31	25	
Availability of Sphygmomanometer	Yes	34	70	0.804	46	58	0.470	50	54	0.045
	No	75	145		88	132		80	140	
Availability of Glucometer	Yes	48	82	0.306	57	73	0.457	62	68	0.023
	No	61	133		77	117		68	126	
Completed CVDs training	Yes	56	109	0.908	70	95	0.691	75	90	0.046
	No	53	106		64	95		55	104	
Interested in taking CVDs training program	Yes	74	166	0.071	95	145	0.273	84	156	0.001
	No	35	49		39	45		46	38	

Barrier 1: Lack of time; Barrier 2: Lack of privacy/space, difficulty in identifying targeted patients, lack of personal; Barrier 4: Lack of tools (educational materials, self-monitoring medical devices, and/or no standard guideline available) as well as skills in using the tools. CP-Community pharmacy; GHP-Government hospital pharmacy; PHP-Private hospital pharmacy; CVDs: cardiovascular diseases; Non-parametric Chi square test was applied to applied to measure the differences among the responses of participants; P-value ≤ 0.05 was considered significant.

This will definitely facilitate the implementation of best healthcare practices supported by pharmacists. Correlation to the number of Saudi pharmacists, 50% of the total pharmacists have experience less than 5 years that strongly indicated greater job participation of Saudi pharmacists in healthcare over the last 5 years (Almaghaslah *et al*., 2023; Alrasheedy *et al*., 2022; Alruthia *et al*., 2018). As reported before, we observed 50% of pharmacists working in community pharmacy and they are more approachable to society. It means the involvement of community pharmacists in CVDs risk evaluation and awareness program can make a greater impact on the healthcare system (World Health Organization, 2019; Alrasheedy *et al*., 2022; Alruthia *et al*., 2018). As reported earlier, 71% of the participants received an average 50 prescriptions each day and out of those an average of 15 CVDs prescriptions were handled by pharmacists (Alavudeen *et al*., 2023]. Our data indicated that the number of pharmacists working in each shift was appropriate as recommended, particularly if

Table 5: Association between knowledge, attitude and practice with different variables

Variables				*Knowledge*		
	β	R	R Square	Adjusted R Square	SEE	P- value
Age	-0.005	0.005	0.000	-0.003	1.236	0.928
Gender	0.032	0.032	0.001	-0.002	1.235	0.572
Nationality	0.071	0.071	0.005	0.002	1.233	0.203
Region	-0.012	0.012	0.000	-0.003	1.236	0.832
Qualification	-0.037	0.037	0.001	-0.002	1.235	0.502
Experience of practice (in years)	-0.070	0.041	0.002	-0.001	1.235	0.462
Pharmacy types	0.012	0.012	0.000	-0.003	1.236	0.827
Number of prescription/days	0.003	0.003	.000	-0.003	1.236	0.951
Number of pharmacists/shifts	0.043	0.043	0.002	-0.001	1.235	0.444
CVDs prescription	0.003	0.003	0.000	-0.003	1.236	0.951
Sphygmomanometer	0.037	0.037	0.001	-0.002	1.235	0.504
Glucometer	0.039	0.039	0.002	-0.002	1.235	0.482
CVDs training received	-0.067	0.067	0.005	0.001	1.233	0.226
Interested in CVDs training	-0.139	0.139	.019	0.016	1.224	0.012
Variables				*Attitude*		
Age	0.028	0.028	0.001	-0.002	5.303	0.614
Gender	-0.183	0.183	0.033	0.030	5.216	0.001
Nationality	0.121	0.121	0.015	0.011	5.267	0.030
Region	-0.149	0.149	0.022	0.019	5.246	0.007
Qualification	-0.217	0.217	0.047	0.044	5.178	0.000
Experience of practice (in years)	0.025	0.025	0.001	-0.002	5.304	0.653
Pharmacy types	-0.097	0.097	0.009	0.006	5.280	0.081
Number of prescription/days	0.029	0.029	0.001	-0.002	5.303	0.599
Number of pharmacists/shifts	0.010	0.010	0.000	-0.003	5.305	0.852
CVDs prescription	0.029	0.029	0.001	-0.002	5.303	0.599
Sphygmomanometer	-0.018	0.018	0.000	-0.003	5.304	0.744
Glucometer	0.074	0.074	0.005	0.002	5.291	0.183
CVDs training received	-0.191	0.191	0.036	0.033	5.208	0.001
Interested in CVDs training	-0.043	0.043	0.002	-0.001	5.300	0.446
Variables				*Practice*		
Age	0.054	0.054	0.003	0.000	4.054	0.333
Gender	-0.250	0.250	0.062	.059	3.931	0.000
Nationality	0.062	0.062	0.004	0.001	4.052	0.263
Region	0.047	0.047	0.002	-0.001	4.055	0.395
Qualification	0.039	0.039	0.002	-00.002	4.057	0.484
Experience of practice (in years)	0.197	0.197	0.039	0.036	3.980	0.000
Pharmacy types	-0.159	0.159	0.025	0.022	4.008	0.004
Number of prescription/days	-0.057	0.057	0.003	0.000	4.053	0.304
Number of pharmacists/shifts	-0.037	0.037	0.001	-0.002	4.057	0.503
CVDs prescription	-0.057	0.057	0.003	0.000	4.053	0.304
Sphygmomanometer	-0.057	0.080	0.006	0.003	4.047	0.153
Glucometer	-0.007	0.007	0.000	-0.003	4.060	0.928
CVDs training received	0.032	0.032	0.001	-0.002	1.235	0.572
Interested in CVDs training	-0.284	0.284	0.081	0.078	3.893	0.000

CVDs: Cardiovascular diseases; R: Correlation coefficients; β: Standardized coefficient; SEE: Standard error of estimate. Data showing the multiple regression analysis model, applied to measure associations of knowledge, practice, and attitude of participants with different variables; P-value ≤ 0.05 was considered significant.

considering the community pharmacists (Almaghaslah *et al*., 2023; Aljabnoor *et al*., 2020). Corroborating these above-mentioned facts, pharmacists working alone were getting less time for managing the prescription in their daily working shifts. Consequently, a shortfall in patient counselling services was observed. Pharmacists are well trained to participate in the point-of-care testing (POCT) process, and the involvement of pharmacy technicians may improve POCT efficiency. Unfortunately, only a limited percentage of pharmacists reported the availability of sphygmomanometer/glucometer in pharmacy that clearly supports the lack of time and not getting involved in disease related discussion with CVDs patients and possibly others too (Rasheed *et al*., 2023; Pope *et al*., 2021).

Apart from major involvement of pharmacists, knowledge of the pharmacists regarding CVDs risk has been considered as a major concern (Al-Ashwal *et al*., 2022). Surprisingly, pharmacists were not interested in participating in training programs for improving their knowledge. In fact, continuing medical education (CME)

promotes professional developments is the necessity to improve pharmacy practice and professional recognition (Kandasamy *et al*., 2023; Nguyen *et al*., 2018). In addition to CVDs related knowledge among pharmacists, our study revealed the highest positive attitude (92%), which is in line with various previously published studies (Al-Ashwal *et al*., 2022; Rababah *et al*., 2023). In a good favour, pharmacy graduates showed the highest level of positive attitude in CVDs management. It reflects their remarkable dedication to these crucial aspects of healthcare. Taking care of the attitudes of the pharmacists, level of education was strongly associated with the attitude of pharmacists on CVDs risk assessment and management. This clearly suggests necessity of motivation in reference to its importance in evidence-based practice. Moreover, pharmacists working in community pharmacy, prescription transcribed and dispensed per day, number of prescriptions containing CVDs related medications, and tools availability greatly impacted the positive attitude for CVD management in pharmacy (Al-Ashwal *et al*., 2022; Rababah *et al*., 2023). As per the practice is concerned, data showed that male Saudi pharmacists were positively taking part in CVDs risk reduction strategies during practice of pharmacy (prescription handling) (Ashwal *et al*., 2022; Rababah *et al.*, 2023). However, pharmacists were not interested in attending CVDs related training programs associated with index practice, as similar to knowledge (one of the indices of KAP). This calls for serious attention to motivate the pharmacists regarding the importance of training and continuing medical/pharmacy education for implementing the best patient care system (Almansour *et al*., 2021). Moreover, our study also examined six barriers. Our data revealed that lack of time, privacy, and tools were major hindrance in assessing CVDs related risks and its management by the pharmacists in their healthcare system. Additionally, number of prescriptions per day is also one of the barriers to be major area of concern. Also, lack of time (barrier 1) was another major barrier that hindered the patient pharmacist interaction. More interestingly as reported in previous studies, lack of tools (barrier 4) has been recognized as another major barrier, as reported by the pharmacists. It included lack of knowledge despite good qualification, number of the pharmacists, availability of sphygmomanometer/ glucometer as well as CVDs training accomplished/ interested in CVDs related training. As we reported earlier, a major portion of pharmacists participated were at the young age group. The privacy (barrier 2) either due to space unavailability or due to trust deficit possibly was the major concern (Al-Ashwal *et al*., 2022; Rababah *et al*., 2023; Al-Jamei *et al*., 2019).

Our study found that pharmacists' knowledge, a major area of concern, was not related to any of the variables studied (Al-Ashwal *et al*., 2022; Rababah *et al*., 2023). However, as reported earlier, gender, nationality, qualification and CVDs training received was greatly associated with the pharmacists' attitude. Similarly, variables such as gender, work experience, pharmacy types, and pharmacists interested in CVDs related training programs had strong relationships with index practice of KAP among pharmacists (Al-Ashwal *et al*., 2022; Rababah *et al*., 2023). Concerning the relationship between respective barriers studied and different variables, our data clearly revealed that there was no relationship between any of variables taken into consideration and barrier 1 (lack of time). However, barrier 2 (lack of privacy) showed strong relationship with age, qualification, experience as practicing pharmacist, sphygmomanometer, glucometer, and pharmacists' interest in attending CVDs training. In a similar fashion, data revealed that barrier 4 (lack of tools) also has a significant relationship with variables such as region, and qualification (Al-Jamei *et al*., 2019). Overall, there are some challenges that exist despite the quality education, research, and training. However, making awareness about the continuing medical education is of utmost demand of time even though there was a positive pharmacists' attitude. Thus, for overcoming these challenges in the context of expanding the clinical pharmacist's role is the need of hour in Saudi Arabia to implement a better health care system (Almalki *et al*., 2023).

Study limitations

Although this study captured the knowledge, attitude, and practice of participants about risk assessment, there were some limitations. First, data collection was done only in the Asir region and thus limits its generalizability. However, it is reasonable to accept the knowledge and practice gaps across the country. Secondly, there may be inherent sampling bias due to study design.

CONCLUSION

Pharmacists have a high positive attitude toward CVD risk assessment. However, they had insufficient knowledge and only provided limited activities and counselling services for CVD prevention. Participants perceived several barriers to CVD risk assessment services in pharmacies. Therefore, it is crucial to address the identified barriers that hinders pharmacists' involvement in CVD risk assessment and prevention. In addition to the recent policy initiatives by the Ministry of health (MoH) and Saudi FDA aimed at public, there should be a focus on continuous education and training programs to keep healthcare professionals updated on the latest advancements in CVD prevention and management.

ACKNOWLEDGMENTS

The authors extend their appreciation to the Deanship of Research and Graduate Studies at King Khalid University for funding this work through Large Research Project under grant number RGP2/317/45

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