Advances in Medical Education and Practice

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ORIGINAL RESEARCH

The Impact of an Educational Intervention on Enhancing Clinical Knowledge of Physicians and Pharmacists Regarding Statins and Monitoring Parameters: The Experience of a Tertiary Teaching Hospital

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Introduction: Understanding the latest guideline recommendations is crucial for healthcare professionals to apply statin therapy effectively. Thus, the purpose of this study was to evaluate the efficacy of an educational intervention in enhancing the awareness and understanding of physicians and pharmacists concerning risk assessment of Atherosclerotic cardiovascular disease (ASCVD) and the role of statin therapy.

Methods: This pre- and post-intervention study was conducted in Sana'a, Yemen's capital city, at the University of Science and Technology Hospital. The study was done between 11/2021-12/2021, and two separate educational sessions were held. The McNemar's test and Wilcoxon signed-rank test were employed as necessary.

Results: Participants' awareness of the Framingham CVD risk calculator improved significantly from 40.4% pre-intervention to 78.7% post-intervention. Similarly, understanding of the parameters used in the 10-year ASCVD Risk calculator rose from 46.8% pre-intervention to 76.6% post-intervention. The ability to identify high, moderate, and low-intensity statin therapy, for instance, increased from 34% to 63.8% post-intervention. Regarding statins' contraindications, safety, and efficacy monitoring parameters, pre-intervention knowledge was unsatisfactory, and the educational intervention improved it significantly ($p < 0.05$). For physicians, the median ASCVD risk assessment knowledge score was significantly improved from 4 (IQR = 3–5) pre-intervention to 7 (6.25–8) immediately post-intervention, while the statin therapy clinical knowledge median score significantly improved from 3 (1.25–6.5) to 9 (7.25–14.75) post-education intervention, p-values were 0.002 and 0.003; respectively. For pharmacists, a similar significant improvement ($p < 0.05$) in the overall knowledge scores for both ASCVD risk assessment and statin therapy was noted.

Conclusion: The educational intervention improved participants' knowledge of statin therapy and ASCVD risk assessment. Therefore, further education lectures and training programs through continuing medical education on the up-to-date guidelines' recommendations should be regularly implemented to raise awareness and improve the clinical knowledge and appropriateness of statins use in clinical settings.

Keywords: educational intervention, statins, monitoring parameters, ASCVD risk assessment, physicians, pharmacists, risk assessment, Yemen

Introduction

Cardiovascular disease (CVD) prevention is an integral part of global health strategy, with assessment of CVD risk being fundamental in guiding preventive therapy decisions, such as initiating statin therapy.[1] In CVD prevention, the

Received: 31 October 2023
Accepted: 19 April 2024
Published: 30 April 2024

collaboration of healthcare practitioners is essential. In this light, evidence suggests that collaborative care approaches between pharmacists and clinicians lead to better clinical outcomes for individuals with chronic conditions.[2–6] Previous meta-analysis studies showed that team-based care resulted in a higher ASCVD risk reduction with better outcomes than usual care for individuals with chronic diseases such as diabetes mellitus (DM) and dyslipidemia.[1] Despite these benefits, a notable gap exists in the knowledge of pharmacists' and physicians' regarding CVD risk assessment and statin therapy in Yemen.[7]

The implementation of cholesterol management guidelines encounters various barriers, including lack of guideline awareness, outcome anticipation issues, and patient-related factors.[8,9] Significant knowledge gaps are evident among healthcare providers, particularly regarding ASCVD risk assessment and clinical indications for statin therapy.[7,10,11] This lack of awareness and adherence to the latest clinical guidelines significantly could impact the quality of patient care.[12]

Previous research has shown that educational interventions can effectively enhance healthcare professionals' understanding of cholesterol management guidelines or statin therapy, leading to positive patient outcomes, including increased adherence to lipid-lowering medications.[13–19] However, in the Middle East, there is limited data on the impact of educational programs on pharmacists' and physicians' knowledge about statin therapy and ASCVD risk assessment, despite several studies conducted in Jordan and Saudi Arabia. These studies revealed suboptimal overall knowledge among physicians and pharmacists concerning CVD risk estimation, the use of lipid-lowering agents, and adherence to practice-changing recommendations outlined in the recent guidelines for dyslipidemia management.[20–22]

Our recent studies in Yemen have revealed significant gaps in the awareness and application of ASCVD risk assessment and statin therapy recommendations by both physicians and pharmacists. For instance, despite their positive attitude towards cardiovascular risk assessment, physicians generally had limited knowledge and subpar practices.[10] Likewise, while pharmacists exhibited a strong positive stance towards CVD risk assessment, they exhibited limited awareness and fell short in offering adequate activities and consultation services for CVD prevention and statin therapy.[11] Both healthcare groups demonstrated a subpar clinical knowledge of statin therapy, including contraindications, drug-drug interactions, dose intensities, clinical indications, and monitoring parameters.[7]

Given these findings, there is a pressing need for targeted educational interventions to bolster the knowledge and competency of healthcare providers for effective CVD risk assessment and optimal utilization of statin therapy. Therefore, this study was designed and implemented specifically to address these identified gaps, and it aims to evaluate the impact of this educational intervention on enhancing the knowledge of physicians and pharmacists about statin therapy and ASCVD risk assessment. The findings could serve as a baseline for future interventions aimed at improving statin utilization and prescription in Yemen.

Methods

Study Design and Settings

This pre- and post-intervention study was conducted in Sana'a, Yemen's capital city, at the University of Science and Technology Hospital. The study was done between 11/2021-12/2021, and two separate educational sessions were held.

Ethical Consideration

This study, which is part of a project about statin therapy in Yemen, received approval from the Ethical Committee of the Medical Research, University of Sciences and Technology, Sana'a, Yemen (EAC/UST193). Because the participants' names are completely anonymous and the study poses no risk, the ethical committee accepted verbal informed consent. Thus, healthcare professionals who verbally agreed to participate and gave their consent were included in the investigation.

Sample size Calculation

Based on G*Power 3.1.9.7 program and in order to detect a statistically significant difference in knowledge pre-to post-educational intervention, a minimum sample of 35 was required for a medium effect size (0.5), utilizing Wilcoxon signed rank test (match pairs), 80% power, and a significance level (α) of 0.05.[23] Taking a 10% dropout rate into account, a final sample size of 44 is required.

Subjects and Sampling

This study involved physicians, pharmacists and PharmD interns. A convenience sampling technique was employed for participants selection. Physicians from the cardiology, internal medicine, nephrology, and endocrine departments of the University of Science and Technology hospital. These departments were chosen because physicians from these departments could be involved in prescribing statin therapy. Hospital pharmacists and PharmD interns, who were in the final stages of their training and would soon become registered pharmacists, were also invited to participate. With collaboration of the clinical pharmacy and internal medicine departments at the study hospital, researchers sent an invitation announcement one week before the lecture to all physicians in the internal medicine, cardiology, and endocrine clinics, followed by a reminder one day before the session. Physicians and pharmacists involved primarily in statin therapy prescription and dispensing were the target audience for the educational intervention. The study excluded professionals from other clinical specialties such as surgery, obstetrics, oncology, and orthopedics. The number of physicians, registered pharmacists, and PharmD interns invited to participate in the study was approximately 40, 22, and 23, respectively. Physicians and pharmacists who declined to complete the surveys or did not return them were excluded from the study.

Study Instrument

A study tool was utilized from pre-validated questionnaires (face validation, content validation, and reliability tests for the utilized study tool were published previously).[7,10] The survey was structured into four distinct parts. The first section encompassed sociodemographic details. Additional data, such as the number of statins prescriptions dispensed in the previous month and whether the respondents had read any dyslipidemia guidelines, were also collected. The second section included three questions aimed at understanding the general awareness of the guidelines and risk assessment calculators. The third section consisted of 9 items that assessed their knowledge about ASCVD risk assessment. The fourth section contained 18 questions. It was designed to test their clinical knowledge about statin therapy (contraindications, drug-drug interaction, dose intensities, clinical indications, and monitoring parameters). The responses in the knowledge section were graded as follows: the correct answer was given a score of 1 while zero scores were assigned to each wrong or "I do not know the answer". The bias caused by guessing was decreased by providing the "I do not know" answer option for all knowledge questions.

Questionnaire Administration and Educational Intervention

A brief introduction explained the study's objective. There was no monetary compensation for taking part in this study. All physicians were required to fill out a pre-test questionnaire before the session, and they were given 10–15 minutes to complete it. This collected baseline data. After everyone had completed the pre-test questionnaire, the session began. The educational session lasted 60 minutes, and at the end, participants were given the opportunity for discussion and to ask questions. Physicians were asked to complete a post-intervention questionnaire at the end of the session.

The main investigator developed the presentation material using the American Heart Association /American College of Cardiology (ACC/AHA) dyslipidemia guideline recommendations. The presentation content was checked and validated by experts from Universiti Sains Malaysia (professor in clinical pharmacy) and the university of science and technology (cardiologist, head of clinical pharmacy department, and lecturer of clinical pharmacy). The lecture covered a variety of essential topics needed for appropriate utilization of statin therapy for eligible patients, including ASCVD risk assessment and enhancers, the available risk calculators, the differences between them, and how to access and use them freely, the 2018 AHA/ACC guideline recommendations, statin therapy clinical indications, how to choose the right dose intensity based on the patients CVD risk, the best agent in chronic kidney disease (CKD) patients, time to administer, contraindications, drug-drug interactions, and monitoring parameters for safe and effective use of statin medications. Moreover, physician-patient discussions regarding the risks and statin therapy were emphasized. The participants were encouraged to participate in the lecture actively. Following the educational session, participants were given the opportunity to ask questions.

The educational workshop on statin therapy lasted one hour. The lecture was given by a lecturer of the clinical pharmacy department at the University of Science and Technology and was supervised by the head of the clinical

pharmacy department at the hospital. The primary goal of this educational intervention was to increase physicians' awareness of up-to-date guidelines and recommendations regarding statin therapy and ASCVD risk assessment.

Statistical Analysis

The McNemar's test and Wilcoxon signed-rank test were utilized were appropriate. As the sample size was less than 50 participants, we used the Shapiro–Wilk test to check for normality of continuous variables. The P-value was <0.05, indicating non-normal distribution. Therefore, the pre-post improvements in the overall knowledge regarding ASCVD risk assessment and statin therapy were evaluated using Wilcoxon signed-rank test (continuous data). McNemar's test was utilized to see any differences in categorical variables between the data collected prior to and following the intervention. The level of significance was set at $p < 0.05$ for all studies.

Results

Sociodemographic Data

Of the 85 individuals that were targeted for the educational intervention, 47 attended and completed the pre-post educational questionnaires. The remaining participants either only filled out the pre-questionnaire and left or arrived late to the education session, completing the post-questionnaire alone. As a result, we have excluded these incomplete questionnaires from our analysis. The breakdown of participants who completed the pre-post educational questionnaires is as follows: 15 (31.9%) were registered pharmacists, 20 (42.6%) were PharmD trainees, and 12 (25.5%) were physicians. As shown in Table 1, a significant proportion of participants were males (66%), and the majority (49%) were aged between 25–29 years. More than half of the participants (57.4%) had not participated in any professional

Table 1 Participants Demographic Characteristics (N= 47)

Demographic characteristics	Frequency (N)	Percentage (%)
Gender		
Male	31	66
Female	16	34
Age (Years) (mean= 26.36 years)		
<25	16	34
25–29	23	49
≥30	8	17
Professional designation		
Physicians	12	25.5
Registered Pharmacists	15	31.9
PharmD trainee	20	42.6
Did you attend workshops for your professional development during the last year?		
Yes	20	42.6
No	27	57.4
Did you attend any lectures or workshops on cholesterol management during the last year?		
Yes	10	21.3
No	37	78.7

development workshops in the preceding year. The majority of participants did not attend any lectures or seminars on cholesterol management during the previous year (78.7%).

General Awareness About the Guidelines and Risk Calculators

Table 2 compares the awareness of the 2018 AHA/ACC guideline, Framingham, and 10-year ASCVD risk calculators prior to and following the intervention. Before the educational intervention, almost half of patients (48.9%) were aware of at least some of the guideline content, which significantly rose to 74.5% following the intervention (p= <0.001). Also, the participants' awareness of the Framingham CVD risk calculator improved significantly from 40.4% before the intervention to 78.7% after the intervention (p= <0.001). Similarly, 46.8% of participants had knowledge of some or all the factors employed in the 10-year ASCVD risk estimator before the educational intervention, which rose significantly to 76.6% after the educational intervention (p= <0.001).

Pre-/Post-Educational Knowledge of ASCVD Risk Assessment

Table 3 compares the correct answers to questions on knowledge about ASCVD risk assessment prior to and following the educational intervention. There were significant improvements in the knowledge of ASCVD risk assessment in 5 out of 9 questions following the educational intervention. These questions include the age categories for which a 10-year and lifetime ASCVD risk calculation are recommended (p= 0.004 and 0.003, respectively). Also, the ability to identify the 4 groups stratification of 10-year risk assessment has improved significantly (pre: 21.3% vs post: 68.1%, p= <0.001). In addition, the participants' knowledge of chronic inflammatory conditions as risk enhancers for ASCVD increased significantly from 40.4% to 63.8%, p= 0.001. Prior to the educational intervention, a low percentage of participants (27.7%) were aware that the 10-year ASCVD risk calculator could underestimate the risk in individuals with chronic inflammatory diseases. However, the rate significantly increased to 53.2% after the intervention (p= <0.001). Questions that showed no significant differences in correct answers between pre-and post-intervention are shown in Table 3.

Pre-/Post-Educational Knowledge of Statin Therapy

Table 4 compares the correct answers to questions on clinical knowledge about statin therapy prior to and following the educational intervention. Participants had significant improvements for all questions of statin therapy following the educational intervention except for the recommended statin intensity for patients with primary hypercholesterolemia, where there was no significant difference between the pre-and post-education responses.

Before the intervention, 29.8% of the cohort identified the patient group that required ASCVD risk assessment for the commencement of statin therapy; after the intervention, this climbed to 53.2% (p=0.019). Participants' knowledge about the definition of high, moderate, and low-intensity statin therapy rose from 34% to 63.8% after the educational intervention (p= 0.001). Before the intervention, 55.3% of participants correctly identified the daily statin dose considered high intensity, which improved after the educational intervention to 74.5% (p= 0.049). Similarly, only a third of patients were able to identify the moderate-intensity statin dose before the intervention, which increased to more than two-thirds post-intervention (p= <0.001). Knowing the dose intensities is not enough for healthcare providers;

Table 2 Comparison of the Awareness to General Knowledge Questions Pre-and Post-Educational Intervention

Awareness level	Pre-intervention	Post-intervention	p-value [a]
Aware of some, most, or all of the content of the 2018 ACC/AHA cholesterol management guideline	23 (48.9%)	35 (74.5%)	<0.001
Aware of some or all the parameters used in the Framingham CVD risk calculator	19 (40.4%)	37 (78.7%)	<0.001
Aware of some or all the parameters used in the ACC/AHA 10-year ASCVD Risk calculator	22 (46.8%)	36 (76.6%)	<0.001

Note: [a]Using McNemar test.
Abbreviations: ACC/AHA, American College of Cardiology/American Heart Association; ASCVD, atherosclerotic cardiovascular disease; CVD, cardiovascular disease.

Table 3 Comparison of the Responses to ASCVD Risk Assessment Knowledge Questions Pre- and Post-Educational Intervention

Questions	Correct answers		P-value[a]
	Pre-intervention	Post-intervention	
For primary prevention of ASCVD, a 10-year risk calculation is recommended for which age category? Correct answer (40–75 years old)	31 (66%)	43 (91.5%)	0.004
For primary prevention of ASCVD, a lifetime risk calculation instead of a 10-year risk calculation is advocated for which age category? Correct answer (20–39 years old)	12 (25.5%)	26 (55.3%)	0.003
The ACC/AHA stratify individuals according to their 10-year ASCVD risk into: Correct answer (Low, borderline, intermediate, and high risk)	10 (21.3%)	32 (68.1%)	<0.001
A 40 years old male smoker patient with DM and HTN falls into which risk category for future ASCVD Events? Correct answer (High risk)	24 (51.1%)	28 (59.6%)	0.454
According to the 2018 ACC/AHA guideline on the management of blood cholesterol, a 65 years old smoker patient with a history of myocardial infarction (MI) falls into which risk category for CVD? Correct answer (Very high risk)	28 (59.6%)	32 (68.1%)	0.481
During cardiovascular risk assessment for primary prevention, does the presence of chronic inflammatory conditions (such as rheumatoid arthritis, psoriasis, etc.) enhance the individual ASCVD risk? Correct answer (Yes)	19 (40.4%)	30 (63.8%)	0.001
In adults not on lipid-lowering therapy, measurement of a non-fasting plasma lipid profile is effective in estimating ASCVD risk? Correct answer (Yes)	23 (48.9%)	28 (59.6%)	0.359
The ACC/AHA 10-year ASCVD risk calculator may underestimate risk in: Correct answer (Patients with chronic inflammatory diseases)	13 (27.7%)	25 (53.2%)	<0.001
Coronary Artery Calcium Score (CAC) can be useful to refine risk assessment and aid in decision making about statin use, mostly in: Correct answer (Individuals with 10-year ASCVD risk 7.5% - <20%)	24 (51.1%)	30 (63.8%)	0.238

Note: [a]Using McNemar test.
Abbreviations: ACC/AHA, American College of Cardiology/American Heart Association; ASCVD, atherosclerotic cardiovascular disease; CVD, cardiovascular disease; DM, Diabetes mellitus; HTN, Hypertension.

it should be administered to the right patient, depending on his ASCVD risk. For example, participants' awareness of the fact that high-intensity statin should be administered to patients with clinical ASCVD was 57.4% before the intervention, but it increased to 80.9% after the intervention.

Participants' knowledge about the information that rosuvastatin and atorvastatin can be taken any time during the day rose from 21.3% to 44.7% after the educational intervention (p= 0.003). Before the intervention, 23.4% of the participants correctly identified atorvastatin as the agent that does not need dose adjustments for patients with CKD, which rose to 57.4% after the intervention (p<0.001). Regarding the participants' knowledge of statin drug interactions, the correct responses improved significantly. In this light, 19.1% of participants correctly identified the interaction between simvastatin and amlodipine pre-intervention, which increased to 38.3% post-intervention (p= 0.012). Before the intervention, 44.7% of participants were aware that rosuvastatin has the safest interaction profile with clarithromycin, which rose to 70.2% post-intervention (0.002). Regarding statins' contraindications, safety, and efficacy monitoring parameters, pre-intervention knowledge was unsatisfactory, and the educational intervention improved it significantly (Table 4).

Table 4 Comparison of the Correct Responses to the Clinical Knowledge of Statin Therapy Pre- and Post-Educational Intervention

Questions	Correct answers		P-value[a]
	Pre-intervention	Post-intervention	
It is recommended to initiate statin therapy without ASCVD risk assessment in all the following patients EXCEPT: Correct answer (Obese and smoker patient aged 42 years old)	14 (29.8%)	25 (53.2%)	0.019
What percent of LDL-C reduction would you expect from low, moderate and high-intensity statin daily therapy? Correct answer (< 30% for low, 30- <50% for moderate, and ≥50% for high-intensity statin therapy)	16 (34%)	30 (63.8%)	0.001
Which of the following daily doses of statin therapy is considered a high-intensity statin? Correct answer (Rosuvastatin 20mg)	26 (55.3%)	35 (74.5%)	0.049
Which of the following daily doses of statin therapy is considered a moderate-intensity Statin? Correct answer (Rosuvastatin 10mg)	16 (34%)	32 (68.1%)	<0.001
Which of the following statin intensity is recommended for adult patients with clinical ASCVD such as myocardial infarction and angina? Correct answer (High-intensity statin)	27 (57.4%)	38 (80.9%)	0.027
Which of the following statin intensity is recommended for adult patients with severe primary hypercholesterolemia (LDL-C level ≥190 mg/dL [≥4.9 mmol/L])? Correct answer (High-intensity statin)	29 (61.7%)	30 (63.8%)	1.00
Which of the following statin-intensity is recommended for a 40-years old patient with only diabetes mellitus type 2 with LDL-C level of 80 mg/dL? Correct answer (Moderate-intensity statin)	25 (53.2%)	34 (72.3%)	0.049
Which of the following statin medications can be taken by patients at any time of the day? Correct answer (Atorvastatin and Rosuvastatin)	10 (21.3%)	21 (44.7%)	0.003
Which of the following statin medications does not need dose adjustment in chronic kidney disease? Correct answer (Atorvastatin)	11 (23.4%)	27 (57.4%)	<0.001
Which of the following statin medications is associated with clinically significant drug-drug interaction when used in combination with amlodipine? Correct answer (Simvastatin)	9 (19.1%)	18 (38.3%)	0.012
Which of the following statin medications is preferred to use for patients on warfarin to avoid statin-warfarin interactions? Correct answer (Atorvastatin)	9 (19.1%)	30 (63.8%)	<0.001
Which of the following statin medications is the safest to use in patients taking Clarithromycin? Correct answer (Rosuvastatin)	21 (44.7%)	33 (70.2%)	0.002
Generally, statin therapy is contraindicated in pregnancy. Correct answer (Yes)	23 (48.9%)	40 (85.1%)	<0.001
Statin therapy can be used safely during breastfeeding. Correct answer (No)	8 (17%)	26 (55.3%)	<0.001
Statin therapy is contraindicated in active liver disease. Correct answer (Yes)	23 (48.9%)	34 (72.3%)	0.019
It is recommended to assess statin efficacy by measuring LDL-C …… after statin therapy initiation or dose change? Correct answer (1–3 months/4-12 weeks)	12 (25.5%)	22 (46.8%)	0.013
Routine measurement for liver enzymes is not recommended during statin therapy? Correct answer (Yes)	14 (29.8%)	25 (53.2%)	0.019
Routine measurement for creatinine kinase is not recommended during statin therapy. Correct answer (Yes)	19 (40.4%)	29 (61.7%)	0.041

Note: [a]Using McNemar test.
Abbreviations: ASCVD, atherosclerotic cardiovascular disease; LDL-C, Low-density lipoprotein-cholesterol.

The Effect of Educational Intervention on the Improvement of Participants' Overall Knowledge (Categorized by Profession)

Table 5 shows the educational intervention's effect on improving participants' knowledge regarding ASCVD risk assessment and statin therapy. For physicians, the median ASCVD risk assessment knowledge score was significantly improved from 4 (IQR = 3–5) pre-intervention to 7 (6.25–8) immediately post-intervention, while the statin therapy clinical knowledge median score significantly improved from 3 (1.25–6.5) to 9 (7.25–14.75) post-education intervention, p-values were 0.002 and 0.003; respectively, using Wilcoxon signed-rank test. A similar significant improvement (p <0.05) in the overall knowledge scores for both ASCVD risk assessment and clinical knowledge of statin therapy was also noted among the pharmacists. For PharmD trainees, the median ASCVD risk assessment knowledge score improved significantly from 3.5 (2.25–5.75) pre-intervention to 6 (4–7) post-intervention (p-value = 0.003), while the statin therapy clinical knowledge median score significantly improved (p-value = <0.001) from 6.5 (5–8.75) to 11.5 (9.25–13.75).

Discussion

Knowledge about ASCVD risk assessment, statin-drug interactions, contraindications, monitoring parameters, clinical indications, and appropriate dose intensity for patients was significantly improved due to the intervention, indicating that it was both practical and effective. Globally, few studies have evaluated the effect of educational programs on improving knowledge about statin therapy or cholesterol management guidelines.[13–19]

Participants had low knowledge about the 2018 AHA/ACC cholesterol guideline, ASCVD risk assessment, and risk estimators before the intervention. This lack of knowledge could be attributed to a lack of CME related to new guidelines, ASCVD risk assessment, up-to-date training, and primary prevention health programs. After the intervention, the overall knowledge of ASCVD risk assessment improved significantly for all participants (physicians, pharmacists, and PharmD trainees). In a previous study among healthcare providers in the USA, a case-based educational strategy notably enhanced the participants' attitudes and knowledge towards the 2013 AHA/ACC cholesterol guideline.[19] In the same study, the providers' knowledge of the differences between the Framingham risk calculator and 10-year ASCVD risk estimator improved by 31%, from 9% pre-intervention to 40% post-intervention. In our study, participants' general awareness of the 2018 AHA/ACC cholesterol guideline, Framingham, and 10-year ASCVD risk estimators increased significantly by 25.6%, 38.3%, and 29.8%, respectively.

Of note, there were no significant improvements in 4 questions, two of which are case studies related to the risk assessment categorization of patients with high and very high ASCVD risk. A potential reason for this could be that the parts of the education intervention that cover these questions were not fully grasped by the participants. Also, some of these questions are related to new information that was first introduced in the 2018 AHA/ACC guideline (eg, the

Table 5 The Effect of the Educational Intervention on the Improvement of Participants' Knowledge (Categorized by Profession)

Profession		Knowledge about ASCVD risk assessment			Clinical Knowledge of statin therapy		
		Median (IQR)	Z score	P-value[a]	Median (IQR)	Z score	P-value[a]
Physicians	Pre-intervention	4 (3–5)	−3.097	0.002	3 (1.25–6.5)	−2.938	0.003
	Post-intervention	7 (6.25–8)			9 (7.25–14.75)		
Pharmacists	Pre-intervention	5 (3–5)	−2.328	0.020	8 (6–12)	−3.131	0.002
	Post-intervention	5 (5–7)			12 (9–15)		
PharmD trainee	Pre-intervention	3.5 (2.25–5.75)	−2.947	0.003	6.5 (5–8.75)	−3.689	<0.001
	Post-intervention	6 (4–7)			11.5 (9.3–13.75)		

Note: [a]Wilcoxon signed-rank test.
Abbreviations: ASCVD, atherosclerotic cardiovascular disease; IQR, Interquartile range.

application of non-fasting plasma lipid profile in the risk assessment of ASCVD and the definition of very high risk), so it could be that healthcare providers were exposed to this information for the first time during the educational intervention. Therefore, for the new knowledge to be retained, repeated educational intervention and continuing medical education are required.[24]

Regarding the clinical knowledge of statin therapy, including the statin-drug interactions, the intervention improved the participants' knowledge of simvastatin-amlodipine interaction by 19.2%. Previously, a study reported a lack of knowledge about potential medication interactions with statin therapy among physicians in Malaysia, with approximately half of the participants being unaware of the amlodipine-simvastatin interaction.[18] In addition, the participant's ability to identify the safest agent to be used with clarithromycin increased by 25.5%. In these two situations, rosuvastatin is preferred as dose restriction is not required.[25] Therefore, physicians should be aware of the variations between statin medications in terms of drug interaction profiles, particularly with commonly prescribed medications.

Statins are clinically indicated in CKD for primary and secondary prevention, particularly in patients not on dialysis.[26,27] Although the 2018 AHA/ACC guideline considered CKD as a risk enhancer for ASCVD risk, other guidelines (Kidney Disease Improving Global Outcomes (KDIGO) guidelines and the 2019 European Society of Cardiology/ European Atherosclerosis Society (ESC/EAS) guideline for the management of dyslipidemia) recommend statins for patients with stage 3 and 4 CKD regardless of their ASCVD risk.[26–28] However, some statins need dosage adjustments based on creatinine clearance. Therefore, healthcare providers should be aware of the safest statin agents for CKD. Atorvastatin is an example that does not require dose adjustment, even in dialysis patients. A previous study reported that less than half of participants correctly identified the preferable statin in CKD patients.[18] In our study, low level of knowledge regarding preferable statins in CKD patients was noted before the intervention (23.4%). Notably, the intervention improved the knowledge significantly by 34%.

Balcazar et al, did a study that included a systematic review in 2020 to evaluate the impact of educational intervention directed to healthcare professionals on patients' compliance to lipid-lowering medications.[13] The review included six studies. Patients' medication adherence improved in five of the six studies, and healthcare providers' adherence to AHA/ACC guidelines was enhanced in all the studies. Following the systematic review, Balcazar et al, performed an educational intervention in a primary healthcare facility and found that it is practical to enhance patients' compliance to lipid-lowering therapy by targeting and enhancing health providers' awareness, assessment, communication, and patient education skills.[13] On the other hand, other study reported a non-statistically significant difference in the prescriptions of statins for diabetic patients before and after a multifaceted intervention.[17]

Notably, when patient-oriented interventions and physician-directed education were compared in a recent systematic review of Randomized Controlled Trials, authors reported that patient-focused interventions are more effective in increasing statin the prescription rates of statin therapy than physicians education alone.[29] However, it is worth mentioning that healthcare providers perform patient-oriented interventions. Therefore, physicians' knowledge of the up-to-date recommendations of the guidelines is necessary to perform a patient-oriented intervention. Examples of patient-oriented interventions include patient education through mail and telephone communications, encouraging patients to schedule CVD risk evaluations, a personal message from their general practitioners detailing individual CVD risk, benefits from statins, and tailored advice for managing cholesterol levels.[29] On the other hand, physician-directed interventions include automated electronic health record alerts, providing educational materials, conducting training sessions on managing CVD risk factors, organizing workshops and presentations for physicians, and offering a website featuring treatment algorithms and guidelines.[29]

Elnaem et al, found that interactive educational intervention for physicians improved the prescription of statin therapy for DM patients.[30] Moreover, a trial conducted in the United States revealed that considerable gaps in evidence-based statin use in type 2 DM patients might be bridged by a pharmacist intervention aimed at physicians.[31] Similarly, a pharmacist-led intervention was beneficial in achieving dyslipidemia treatment goals and prescribing statins to patients with high CVD risk in the United Kingdom.[32] In addition, a favorable impact was seen after a CV educational intervention aimed at primary care providers.[14] In contrast, a study examining the impact of pharmacist's intervention on improving guideline-directed statin therapy prescription among patients with Acute Coronary Syndrome found that the intervention had no significant effect on the number of patients receiving statins.[33]

As a result, incorporating an education intervention regarding the up-to-date guideline recommendations into Continuing Medical Education (CME) initiatives can potentially improve clinicians' knowledge and practice about the guideline. Given that even slight changes in providers' practice patterns can have a clinical impact,[34] the educational intervention in this study, if done on a wider scale, could positively impact healthcare providers' knowledge and practices.

In community settings, educational interventions have demonstrated significant benefits in preventing cardiovascular diseases. Studies indicate that health promotion efforts targeted at individuals have led to positive outcomes, effectively reducing ASCVD risk factors.[35,36]

The study has few limitations. First, despite the fact that participants' knowledge about ASCVD risk assessment and statin therapy increased as a result of the educational intervention, the educational intervention's effect on practices was not examined, which is a limitation of this study. Additionally, the educational workshop's impact was examined directly following the session, which may not accurately reflect long-term knowledge. Thus, additional research may be needed to ascertain the effect of educational workshops on healthcare providers' long-term knowledge and practices regarding ASCVD risk assessment and appropriate statin therapy use. Furthermore, the study was limited by its small sample size and the fact that it was conducted among healthcare providers from a single hospital. Moreover, a large portion of participants comprised PharmD trainees. As a result, the findings of this study may not be generalizable to consultants, other settings (community centers), or to other hospitals in Yemen.

Conclusion

The educational intervention improved participants' knowledge of ASCVD risk assessment and statin therapy, and monitoring parameters. Although some risk assessment-related questions were not significantly improved after the session, all statin-related knowledge questions were significantly improved. Therefore, further education lectures and training programs through continuing medical education on the up-to-date guidelines' recommendations should be regularly implemented to raise awareness and improve the clinical knowledge, safety, and appropriateness of statins use in clinical settings.

Disclosure

The authors report no conflicts of interest in this work.

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