Original Research

Efficacy of Continuing Education in Improving Pharmacists' Competencies for Providing Weight Management Service: Three-Arm Randomized Controlled Trial

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Introduction: *Weight management is a new public health role for community pharmacists in many countries. Lack of expertise is one of the key barriers to counseling obese patients. We evaluated the comparative efficacy of three alternative continuing education (CE) meetings on weight management.*

Methods: *We designed a randomized controlled trial comparing didactic lecture, lecture plus case discussion, and lecture plus small-group training. It was conducted in 2011 in Tehran. Pharmacists' knowledge, attitudes, and competence were evaluated immediately before, immediately after and one month after each meeting via standardized questionnaires and case vignettes. Participants' satisfaction was evaluated after each meeting. Data were analyzed using repeated measure analysis of variance and chi-squared tests.*

Results: *Sixty pharmacists were randomly allocated to each study arm. There were no demographic differences between the arms at the baseline. The knowledge scores significantly improved for all interventions over time. At the follow-up, the small-group training arm obtained significantly higher knowledge scores (*$p < 0.001$*, effect size =0.54). The competence scores in lecture plus case discussion and lecture plus small-group training meetings improved over time (effect size 0.14 and 0.34; difference nonsignificant). Small-group training resulted in significantly higher satisfaction scores (*$p = 0.005$*). The interventions' effects on attitudes were similar.*

Discussion: *This is the first study on the implementation and efficacy of various types of CE meetings for community pharmacists to provide weight management services. Lecture plus small group training resulted in better learning retention over time and higher satisfaction. Future studies should evaluate the effects of various types of CE meetings on pharmacists' behavior and their cost-effectiveness.*

Key Words: *weight management, community pharmacist, continuing education, small group training, randomized controlled trial, provider behavior, knowledge, competence*

Introduction

The pharmacy profession has changed enormously in recent decades. Globally, pharmacists in institutional and

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community settings are now being asked to not only formulate and dispense medications but also provide pharmaceutical care and public health services.[1–3] Providing weight management services has been identified as an important new role in public health for community pharmacies.[4–7] Obesity is one of the greatest public health concerns in the 21st century.[8,9] In Iran, the prevalence of obesity (body mass index [BMI] >30) and overweight (BMI between 25 and 29.9) combined is estimated to be 43% in men and 57% in women.[10] Both national and international health authorities have urged interventions to control this significant and growing challenge.[11,12] However, many pharmacists cite a lack of expertise and medical knowledge about obesity as barriers to counseling obese patients and have indicated that appropriate training could improve their practice behavior.[13,14]

The lack of knowledge and skill suggests a role for continuing education (CE) as a means of improving weight management counseling among pharmacists. As health care professionals, pharmacists are required to maintain and improve their competencies through CE.[15] Since 1991, CE has been mandatory in Iran. Pharmacists are required to obtain CE credits every year for license renewal (25 hours of CE).[16] Also, theoretical support for an educational approach is found in the Holland–Nimmo pharmacy practice change model, which highlights three main domains: motivational strategies, practice environment, and learning resources.[17] As suggested by this model, learning resources such as CE intervention, might enable pharmacists to change their practice behavior. Literature on the effectiveness of continuing education in the medical field has revealed that CE can produce some improvements in knowledge, skills, and practice behavior of physicians.[18–20] The evidence also shows that the impact of CE meetings and workshops, the most popular types of CE, is influenced by several factors such as instructional formats (didactic, interactive, or mixed), attendance rate at the meetings, use of reinforcement tools, and complexity of the behavior expected to change.[21]

Despite this body of literature, much remains to be learned about the design of effective educational interventions for improving patient care, especially in the context of community pharmacy. Continuing pharmacy education has not been a major research priority. There have been some studies investigating cognitive gains and behavioral impacts, but the results have been mixed.[22–25] In addition, direct comparisons of different types of educational interventions are rare.[21]

In the present study, we conducted a randomized controlled trial involving three different CE interventions focusing on evidence-based weight management (each lasting 1 day). The instructional methods used in the 3 arms were (1) didactic lecture, (2) didactic lecture plus large-group interactive case discussion, and (3) didactic lecture plus small-group training with simulated patients. The didactic lecture arm was considered an active control group. We assessed the effects of the meetings on relevant outcomes based on the Moore et al framework,[26] comparing the effects on participants' satisfaction (Level 2), knowledge (declarative knowledge) and attitudes (Level 3A), and competence (Level 4).

The hypotheses tested were (1) whether participants' satisfaction varies with each type of CE meeting, (2) whether there is a difference among interventions in improving participants' declarative knowledge or attitudes, and (3) whether there is a difference among interventions in improving participants' competence in providing weight management counseling.

Methods

Study Design

This study was a three-arm randomized controlled trial (RCT), registered at ClinicalTrials.gov (NCT01339364). The study was approved by the Pharmaceutical Sciences Research Center ethics committee (Tehran, Iran).

Study Participants and Location

Participants were community pharmacists aged 25 to 65 who volunteered to be in the study. The participants who reported working less than 4 hours per day (1 working shift) in pharmacy practice were excluded from the study. For sample size calculation based on change in knowledge, we assumed a typical moderate to large effect size and a between measure correlation of 0.3,[27] reported in similar studies, requiring 40 participants in each study arm. For purposes of oversampling, 60 pharmacists were assigned to each intervention (FIGURE 1).

Recruitment was performed using invitation with cell phone text messages and presenting at national and local CE meetings. Cell phone numbers were obtained from a database held by the Iranian Clinical Pharmacists Society. After recruiting 180 pharmacists, they were allocated to intervention arms using random number generator software. Randomization was carried out by one of the authors (AR), who was not involved in the education process. Participants were blind to their allocated intervention until they attended the meeting. CE credits were offered free of charge to the pharmacists who participated in the study. The CE meetings were held in the Faculty of Pharmacy, Tehran University of Medical Sciences. All the participants signed informed consent forms before attending the CE meeting.

Educational Content and Design

Principles of adult learning were incorporated into the educational design process. Prior to preparing the content, a qualitative need assessment was performed to identify current pharmacists' educational needs on the subject. This step

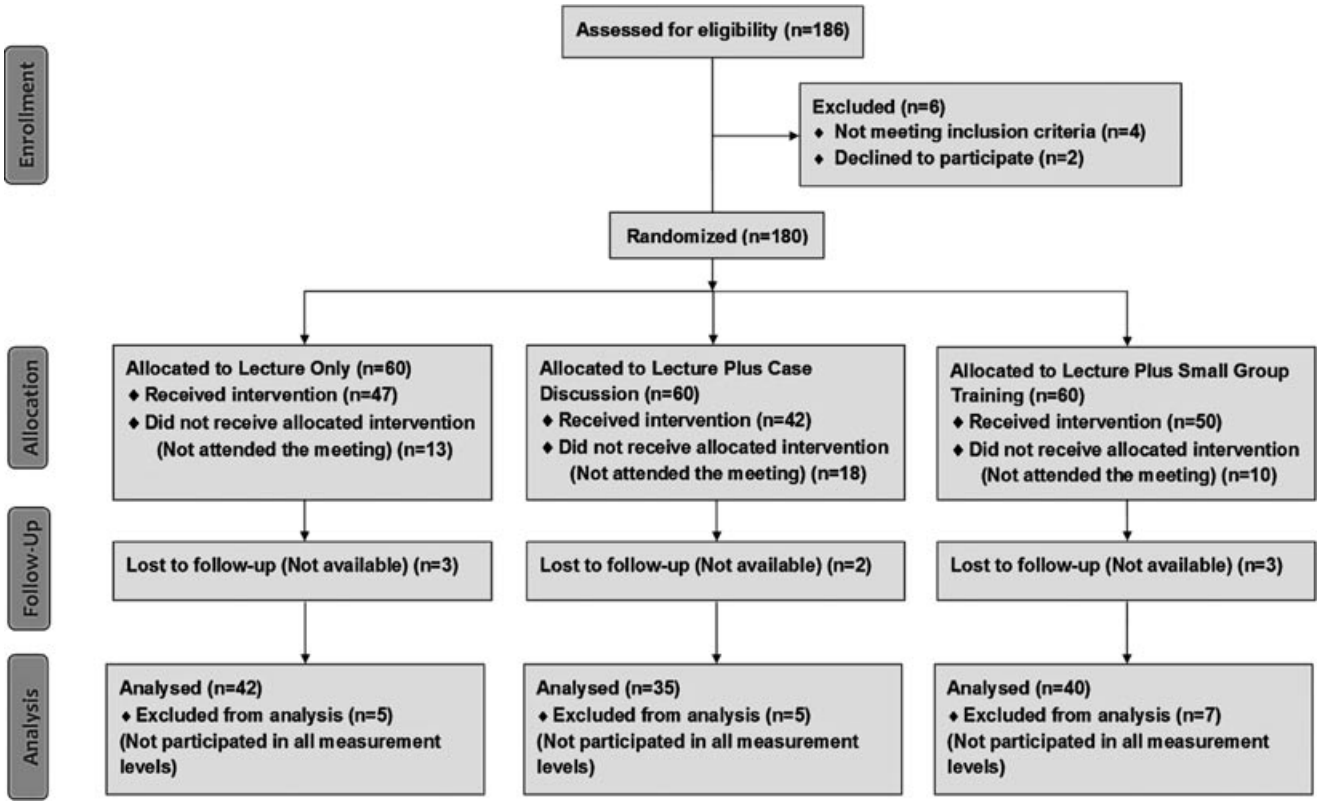

FIGURE 1. Randomization Scheme and Participation Flow of Study Arms

addressed the adult learning principle of training learners based on "real-life problems" and "considering learners' previous knowledge and experience."[28] Unstructured interviews were performed with 8 community pharmacists. Upon sampling saturation, main themes were extracted by thematic analysis. The lecturers were asked to prepare the content based on the identified needs and learning objectives (TABLE 1). The educational content was drawn from three main sources: *Obesity: Preventing and Managing the Global Epidemic* (Report of the World Health Organization Consultation on Obesity),[8] *The Practical Guide: Identification, Evaluation, and Treatment of Overweight and Obesity in Adults* (The National Heart, Lung, and Blood Institute),[29] and *Pharmacotherapy: A Pathophysiologic Approach,* 7th edition.[30] The instructional designs are summarized in TABLE 1. The study arms included the following.

- *Lecture only:* Two didactic lectures (each lasting about two hours) were delivered by two clinical pharmacists. Each lecture was accompanied by a 15-minute question-and-answer period. Both lecturers used PowerPoint presentations.
- *Lecture plus large-group case discussion:* Two didactic mini lectures (each lasting about 1 hour) were presented at the beginning of the session. Three case vignettes were discussed with active participation of pharmacists during the second half of the session (lasting 2 hours). The vignettes were based on the educational content and the sample case scenarios presented in pharmacotherapy textbooks.[31,32] They were modified to comply with the national obesity guideline,[33] and the availability of medications in Iran. Case handouts were available for participants to follow the lecturer.
- *Lecture plus small-group training:* For the lecture plus small-group training intervention, 2 didactic mini lectures (each lasting about 1 hour) were delivered at the beginning of the session. After a break, participants were randomly divided into 3 groups. Each group met in a separate workshop room equipped with a roundtable and whiteboard. Three senior clinical pharmacy residents were assigned as workshop facilitators. They were involved in the study process, attended the lecture plus case discussion intervention to be familiar with the content and were trained to apply the brainstorming technique in the workshops.[34] Three PharmD students were trained as simulated patients (SP). Prior to the intervention, facilitators and SPs attended meetings to coordinate the instruction procedure. SPs presented the same case in all 3 workshops. Pharmacists were encouraged to get involved in discussions based on the educational objectives. The facilitator suggested corrections after all participants in the workshop presented their opinions. Cases presented at lecture plus case discussion and lecture plus small-group training were identical.

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TABLE 1. Need Assessment Findings, Instructional Objectives and Design

Need Assessment Themes

- Weight loss medications and dietary supplements
- Weight loss diets
- Comorbidities and complications of obesity
- Obesity as an adverse drug reaction

Learning Objectives

- Explain the underlying causes of obesity.
- Identify the diagnostic criteria of obesity and accompanying risk factors.
- Recognize desired therapeutic goals for overweight or obese patients.
- Recommend appropriate nonpharmacologic and pharmacologic therapeutic interventions for overweight or obese patients.
- Educate patients about the disease state and associated risks, appropriate lifestyle modi?cations, drug therapy, and surgical options necessary for effective treatment.

Instructional Design

	Lecture only	*Lecture plus case discussion*	*Lecture plus small group training*
Predisposing approach	Full lectures	Brief lectures	Brief lectures
Application exercises	—	Interactive case discussions in hall	Training with SPs in workshops
Exposure time	240 minutes	240 minutes	265 minutes
Enabling tools	BMI charts, Educational CD	BMI charts, Educational CD, case handouts	BMI charts, Educational CD, lecture handout
Reinforcement	Access to faculty via phone and e-mail	Access to faculty via phone and e-mail	Access to faculty via phone and e-mail

Abbreviations: CD, compact disc; BMI, body mass index.

The lecture plus case discussion and lecture plus small-group training instructional designs incorporated the adult learning principles of "active participation in education" and "providing opportunities to practice learning."[28]

CE meetings were held on 3 separate days (1 week apart) from 8:30 a.m. to 1:00 p.m. The lecturers were the same in all 3 interventions. One author (AS) observed each session to conform the accurate delivery of the content. The duration of each session was also noted. A compact disc (CD) was prepared as an enabling tool for all participants in the 3 study arms with the same educational material. It contained full content PowerPoint presentations and a low-calorie diets manual. Access to faculty via e-mail or phone was employed as a reinforcement tool.

Questionnaire Development

We used a standard questionnaire recommended by the Office of Continuing Education for Health Personnel–Ministry of Health and Medical Education.[35] This tool evaluates CE participants' satisfaction with several items such as educational content and instructional design.

We developed a questionnaire to assess declarative knowledge, attitudes, and competence based on the educational content. The preliminary questionnaire consisted of 31 knowledge and competence items (multiple-choice questions and case vignettes, respectively) and 8 attitudes Likert-type items (5-point scales, strongly agree to strongly disagree).[26,36] The content and the face validity of the questionnaire were assessed by 2 clinical pharmacists who were not involved in the instruction process. A pilot test was carried out with 16 community pharmacists to evaluate the internal reliability of the test. In the attitudes part of the questionnaire, 2 items were removed to produce a Cronbach α measure of 0.72 and the total attitudes score reached 30 points. Attitudes questions evaluated the participants' beliefs about obesity and weight management, perceived ability to provide weight management service in community pharmacies, and the patients' acceptance to receive the service. Knowledge and competence items were reduced to 18 multiple-choice questions and 2 case vignette essays (11 items). The vignettes assessed competencies in BMI calculation, risk factor assessment, identification of therapeutic options, life style modifications, managing anti-obesity medications and patient education. Each correct answer to the knowledge or competence

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items was counted as one point in scoring the responses, allowing for maximum scores of 18 and 11 on knowledge and competence, respectively. Sample questions are provided in the Supporting Information for this article.

The lecturers and small group facilitators were blind to the questionnaire content. One author (HT), who was blind to the allocation of the participants to the intervention arms, scored responses to the case vignettes.

Data Collection

Paper-based questionnaires were used to collect data on demographics, knowledge, attitudes, competence, and satisfaction for all measurement occasions. The demographic questions included age, sex, self-reported BMI, graduation year, practice characteristics, previous exposure to the subject, and frequency of weight management consultation. The knowledge, attitudes, and competence test, with the same content, was administered on 3 measurement occasions for each intervention; (1) immediately before CE (pretest), (2) immediately after CE (posttest), and (3) 4 weeks after CE (follow-up).

We employed a courier service to collect the follow-up data. We set an appointment with each participant to send the questionnaire. The courier delivered the questionnaire at the agreed time, waited for the participant to complete the questionnaire, and brought back the filled-out questionnaire. Satisfaction assessment was performed at the end of each training day. The participants also rated their overall satisfaction with the CE meeting and other training tools in the follow-up test.

Analysis

Declarative knowledge, attitudes, and competence items were analyzed separately. We used repeated measure analysis of variance (ANOVA) as the conservative method for participants who completed all measurement occasions. Data were subjected to a 3×3 repeated-measure ANOVA using 1 between-subject factor (intervention arms) and 1 within-subject factor (pretest, posttest, and follow-up). We used simple pairwise comparisons with Bonferroni's adjustment to identify within- and between-arms difference. We further analyzed the relationships between each study outcome and potential modifying variables including age, sex, years since graduation, daily practice time, and other background characteristics, using linear regression, repeated measure ANOVA, and analysis of covariance. Participants' satisfaction was compared using the Pearson chi-squared test. Baseline characteristics were compared using ANOVA and Pearson chi-squared analyses. Analysis was based on intention to treat. Statistical significance level was set as a p value < 0.05.

Results

Of 180 pharmacists recruited (60 in each intervention), 139 attended the CE, and 117 of the participants completed all the assessment procedures. The 16% attrition rate was within the range of educational RCTs' guidelines.[37] Dropouts from intervention arms did not differ significantly in age, daily practice time, previous exposure to the subject, and pretest scores. Baseline characteristics of the participants were not significantly different among intervention arms (TABLE 2).

Overall, the use of the reinforcing options of e-mail or phone to the faculty was low in all arms. Three inquiries were made by phone in the follow-up period, one from lecture plus case discussion arm and 2 from lecture plus small-group training arm.

Satisfaction

There were no significant differences between arms for participants' ratings of the extent to which the educational content succeeded in presenting up-to-date knowledge and complied with their professional requirements ($p = 0.22$). Highest satisfaction was reported with the lecture plus small-group training intervention regarding session interactivity and its motivating impact for further training (79.2% and 89.6%, respectively). Participants in the lecture plus small-group training intervention were also more satisfied with the instructional design ($p = 0.01$). The participants in lecture plus small-group training arm rated their overall satisfaction at the follow-up time at 89.7% ("excellent" or "very useful"). This was significantly higher than the lecture only and lecture plus case discussion arms (57.5% and 71.4%, respectively; $p = 0.005$).

Declarative Knowledge

Using repeated measure ANOVA, a significant interaction effect was observed between study arms and data collection time points (sphericity assumption not violated: $p = 0.34$; $F\ (4, 228) = 5.59$, $p < 0.001$; partial $\eta^2 = 0.89$). Knowledge score means are shown in FIGURE 2. Simple pairwise comparisons revealed no significant difference between the arms in either the pretest or the posttest. At the follow-up, the participants in the lecture plus small-group training arm scored significantly higher than the lecture only and lecture plus case discussion arms ($p = 0.002$ and 0.001, respectively) suggesting a better knowledge retention over 4 weeks (TABLE 3).

In within groups' simple comparisons, scores significantly increased from the pretest to posttest and from the pretest to follow-up (all p values < 0.001). The scores significantly decreased from posttest to follow-up in the lecture only and lecture plus case discussion arms (all p values < 0.001). There was no significant decrease in the lecture plus small-group training arm ($p = 1.00$), which shows that the participants

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TABLE 2. Participants' Characteristics[a]

Pharmacists' Characteristics	Didactic Lecture	Didactic Lecture/Case Discussion	Didactic Lecture/Small Group Training	P value[b]
Age	42.6 ± 8.6	42.9 ± 10.5	42.0 ± 9.9	0.90
Gender				0.65
Male	14(29.8)[b]	13(32.5)	12(24.0)	
Female	33(70.2)	27(67.5)	38(76.0)	
Year since graduation	16.7 ± 8.8	16.3 ± 10.3	16.0 ± 8.9	0.94
Daily practice time				0.33
Part-time	20(46.5)	18(48.6)	27(61.4)	
Full-time	23(53.5)	19(51.4)	17(38.6)	
Pharmacy owner				0.25
Yes	28(59.6)	19(47.5)	21(42.0)	
Previous exposure to the subject[c]				
Undergraduate	9(19.1)	4(10.0)	7(14.0)	0.48
Continuing education	5(10.6)	4(10.0)	3(6.0)	0.68
Self-study	29(55.3)	19(60.0)	21(46.0)	0.38
None	19(34.0)	17(30.0)	29(46.0)	0.25
Weight management consultation per month				0.52
<5	13(27.7)	10(25.0)	9(18.0)	
5–10	9(19.1)	12(30.0)	17(34.0)	
10–15	6(12.8)	6(15.0)	7(14.0)	
>15	17(36.2)	9(22.5)	11(22.0)	
Type of consultation[c]				
Assessment of obesity	6(12.8)	10(25.0)	5(10.0)	0.13
Obesity as an ADR	13(27.7)	14(35.0)	11(22.0)	0.42
Weight reduction diet	29(55.3)	20(50.0)	27(54.0)	0.82
Weight loss medication or dietary supplement	41(87.2)	29(72.5)	43(86.0)	0.07
Other	4(8)	6(14)	8(16)	0.50
Self-reported BMI	25.1 ± 3.8	24.2 ± 3.6	24.4 ± 3.5	0.53

Abbreviations: ADR, adverse drug reaction; BMI, body mass index.
[a]Numbers shown in parentheses are percentages.
[b]One-way ANOVA for continuous data, Pearson χ^2test for discrete data.
[c]Participants were allowed to choose as many choices as they found relevant.

in this arm had retained their declarative knowledge gained in the CE meeting (TABLE 4). Overall, the effect sizes for the lecture only, lecture plus case discussion, and lecture plus small-group training arms were 0.41, 0.37, and 0.58, respectively.

Attitudes

No significant interaction was observed between the study arms and data collection time points (sphericity assumption not violated: $p = 0.27$; F (4, 228) = 0.60, $p = 0.66$), although mean attitude score of all study participants improved significantly over time (F (2, 228) = 11.88, $p < 0.001$; $\eta^2 = 0.09$).

Competence

As illustrated in FIGURE 3, significant interaction was observed between the study arms and data collection time points (sphericity assumption violation: $p = 0.02$; Greenhouse-Geisser correction ($\varepsilon = 0.938$): F (3.75, 213.91) = 4.79, $p = 0.001$; partial $\eta^2 = 0.08$). In pairwise comparisons

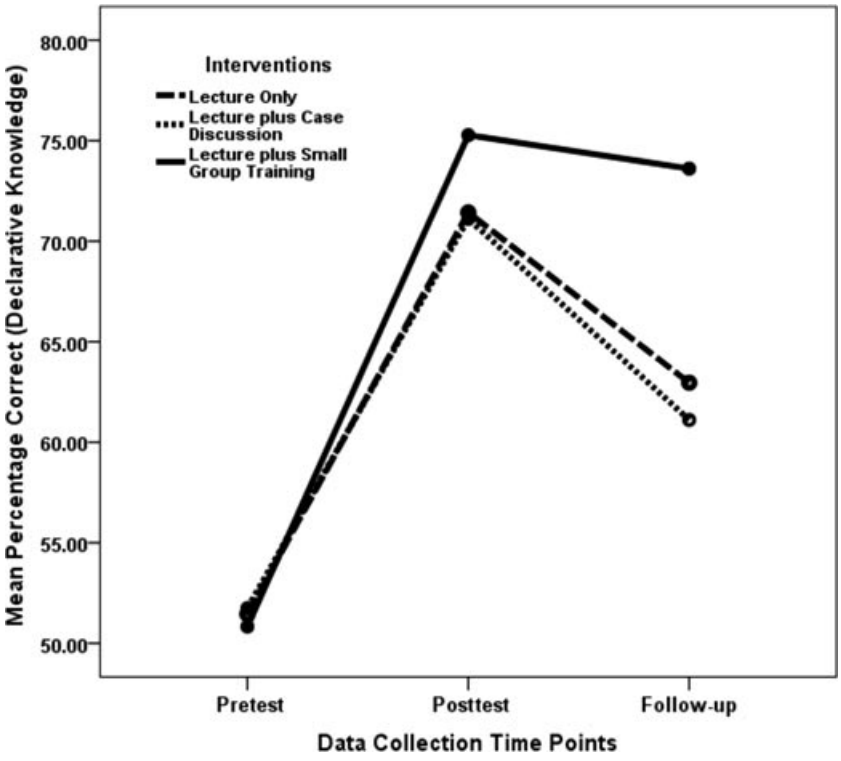

FIGURE 2. Estimated Mean of Declarative Knowledge Test Scores

TABLE 3. Mean Percentage of Correct Responses to Declarative Knowledge and Competence Tests[a]

Outcome	Data Collection Time Point	Lecture Only	Lecture Plus Case Discussion	Lecture Plus Small-Group Training	*p* values
Declarative knowledge	Pretest	51.4(47.3 to 55.6)	51.7(47.2 to 56.2)	50.8(46.6 to 55.0)	0.95
	Posttest	71.4(67.0 to 75.9)	71.1(66.2 to 76.0)	75.3(70.7 to 80.0)	0.38
	Follow-up test	62.9(58.7 to 67.2)	61.1(56.4 to 65.8)	73.6(69.2 to 78.0)	<0.001
Competence	Pretest	32.9(26.0 to 39.8)	30.1(22.6 to 37.6)	25.7(18.6 to 32.7)	0.34
	Posttest	42.6(34.4 to 50.8)	45.7(36.7 to 54.7)	53.6(45.2 to 62.1)	0.17
	Follow-up test	40.5(32.0 to 47.0)	47.0(38.8 to 55.2)	54.8(47.1 to 62.4)	0.034

[a]Numbers in parentheses are 95% confidence intervals.

between the arms, pretest and posttest competence scores did not differ significantly among interventions (TABLE 3). On the contrary, participants in the lecture plus small-group training arm obtained significantly higher scores in comparison to lecture only arm at the follow-up ($p = 0.03$).

According to the within-group comparisons (TABLE 4), competence scores in both lecture plus case discussion and lecture plus small-group training arms improved significantly in posttest and were retained at follow-up (all p values $<$ 0.01, partial $\eta^2 = 0.14$ and 0.36, respectively). In contrast, a lecture-only CE meeting could not significantly improve participants' competence score ($p = 0.053$, partial $\eta^2 = 0.05$).

Discussion

A 1-day CE meeting on evidence-based weight management, tailored for community pharmacists, brought substantial knowledge and competence gains. The participants in the

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TABLE 4. Simple Comparisons for Declarative Knowledge and Competence Tests within each intervention[a]

Outcome	Intervention	Mean Difference Between Data Collection Time Points			Effect Size[b]
		Post-Pre	Follow up-Pre	Follow up-Post	
Declarative knowledge	Lecture only	19.0(14.5 to 25.4)[c]	11.5(6.5 to 16.4)[c]	−8.5(−13.3 to −3.6)[c]	0.41
	Lecture plus case discussion	19.4(13.4 to 25.3)[c]	9.4(4.0 to 14.8)[c]	−10.0(−15.3 to −4.7)[c]	0.37
	Lecture plus small-group training	24.4(18.9 to 30.0)[c]	22.8(17.7 to 27.8)[c]	−1.7(−6.6 to 3.3)	0.57
Competence	Lecture only	9.7(−0.4 to 19.9)	7.6(−1.2 to 16.4)	−2.2(−10.3 to 6.0)	0.05
	Lecture plus case discussion	15.6(4.5 to 26.7)[d]	16.9(7.2 to 26.5)[c]	1.3(−7.7 to 10.2)	0.14
	Lecture plus small-group training	27.9(17.6 to 38.3)[c]	29.1(20.0 to 38.1)[c]	1.1(−7.2 to 9.5)	0.36

[a]Numbers in parentheses are 95% confidence intervals.
[b]Effect size calculated as partial eta squared.
[c]p value < 0.001.
[d]p value < 0.01.

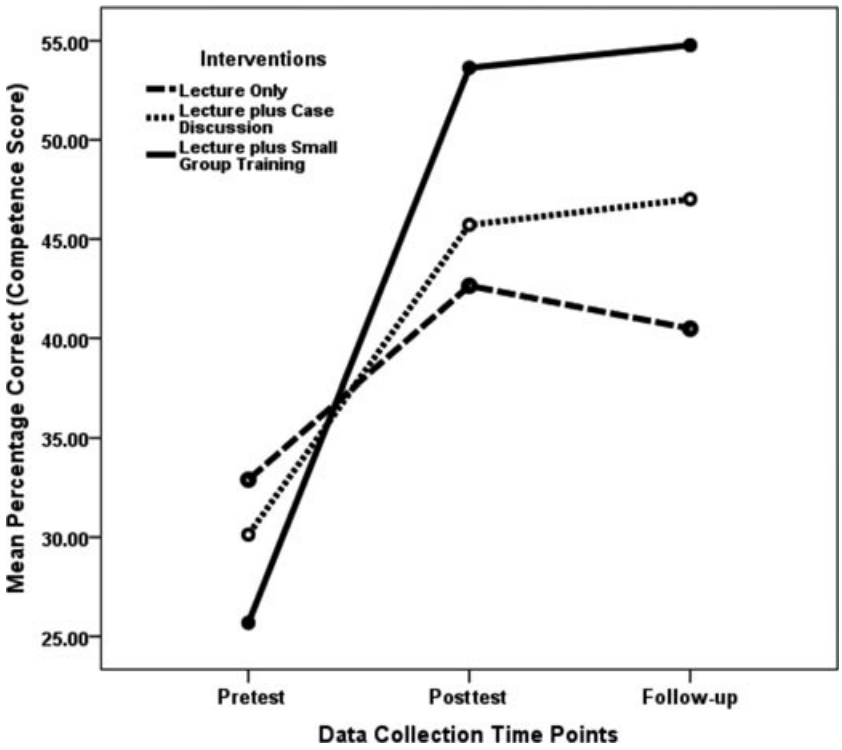

FIGURE 3. Estimated Mean of Competence Test Scores

lecture plus small-group training arm obtained significantly higher knowledge scores at the 4-week follow-up. Also, the participants in the lecture plus small-group training intervention reported higher satisfaction rates with the CE meeting.

Recent evidence suggests that CE meetings with mixed-method formats are the most effective approaches in improving practice behavior and patient outcomes.[21] In the present study, we compared 3 instructional design: 1

nonintensive didactic intervention (lecture only) and 2 interactive interventions (lecture plus small-group training and lecture plus case discussion). Our findings show that lecture plus small-group training (a more intensive design) is the most effective method in improving pharmacists' declarative knowledge, although lecture plus case discussion (a less intensive design) and lecture-only intervention could also increase participants' knowledge significantly.

According to our results, lecture plus case discussion and lecture plus small group training are more effective methods in improving participants' competence. This finding implies that both mixed-method instructional designs are effective CE approaches for developing participants' competence. We note, however, that the effect size of lecture plus small-group training was greater than the lecture plus case discussion (0.36 versus 0.14), although the difference was not statistically significant. This finding might suggest that the greater knowledge gains for participants in the small-group training were not totally translated into higher competency levels as measured by case vignettes.

There may be other explanations for this finding. We have lacked statistical power to demonstrate a difference between lecture plus case discussion and lecture plus small group training in improving competence. It might also be a limitation of case vignettes as competence assessment tools.[36] For example, the vignettes lacked the ability to assess competencies such as communication skills, which are more likely to be developed in the small-group training sessions with simulated patients.

In spite of the limitations of case vignettes as competence assessment tools, they have potential merits. Recent studies have shown that appropriately designed vignettes are valid and relatively inexpensive tools for measuring clinicians' behavior and quality of care in different fields such as surgical care and internal medicine.[38–40] Still, future studies should investigate the validity and reliability of vignettes in quantifying pharmacists' behavior. Hence, our findings should be interpreted with caution.

Literature on continuing pharmacy education has revealed mixed results so far. Some studies have reported no difference in learning gains and practice behaviors between various types of CE.[22,25] They included didactic and interactive meetings, educational outreach, and printed materials. In contrast, there have been reports that CE meetings for pharmacists could improve learning outcomes and practice behaviors in asthma management and smoking cessation; nevertheless, those studies had some limitations due to lack of control groups or sample size calculation.[24,41] One possible underlying factor in such discrepancies could be the timing of outcome assessments. In the aforementioned studies, the timing of outcome assessments varied from just after training to five months thereafter. In the present study, short-term knowledge and competence gains were not different among the interventions. Conversely, significant differences were observed at 1-month follow-up. This finding suggests that future studies on CE should assess both short- and long-term effects. It will provide a better understanding of the CE outcomes deterioration or development process.

No significant difference was observed between the interventions in improving attitudes. It is assumed that small group training is the best method to change attitudes.[34] Participants in our study, in spite of possessing low baseline knowledge and competence, reported highly positive attitudes at baseline. Hence, we may have observed a ceiling effect so that the capacity to improve was small in all intervention arms and no difference was observed as a result.

Strengths and Limitations

We employed a robust study design with multiple considerations to minimize the risk of bias. Random allocation was carried out by a member of the team who was not involved in the conduct of the meetings or recruitment. Blindness of the educators to the assessment tool minimized the risk of scores' overestimation. Blinding of our team member to the questionnaire identification minimized the risk of bias in scoring case vignettes. Our study interventions were arranged to take the same length of time. This approach could eliminate the confounding factor of instruction exposure time usually observed in studies comparing interactive and didactic methods.[16] Study participants were diverse and represented varying levels of age, experience, and knowledge, although representativeness of the sample could not be assured.

We did not use probability sampling methods and a group of motivated community pharmacists were recruited. Also offering CE credits free of charge may have contributed to pharmacists' participation. This self-selection was unpreventable but complies with the principles of adult learning; education based on self-perceived needs;[28] thus, the results could be generalized to motivated groups of pharmacists. Lack of a theoretical framework in designing the attitudes component of the questionnaire may have affected its validity; however, this limitation could be observed in other related studies.[42,43]

Approximately all participants were practicing in urban community pharmacies. We did not document if pharmacists practicing in the same pharmacy were allocated to different interventions, thus the risk of contamination could not be eliminated. This risk, however, is small as most pharmacies have only one pharmacist. If the risk of contamination exists, it will not affect the validity of the main findings, as contamination would dilute the interventions' effect and reduce the difference between the intervention arms.

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Lessons for Practice

- Weight management is a new public health role for community pharmacists.
- No evidence exists on the effects of CE meetings on improving community pharmacists' knowledge and competencies for providing weight management services.
- Different methods of CE meetings can improve short-term knowledge of community pharmacists.
- Lecture plus small-group training is the effective method for improving longer-term knowledge and competencies in weight management and results in higher satisfaction.
- Future studies should focus on evaluating the effects of various types of CE meetings on the pharmacists practice and the cost-effectiveness of each educational approach.

To the best of our knowledge, this is the first study to report the efficacy of implementing various live CE interventions on weight management to improve community pharmacists' knowledge and competencies. Further studies are required to evaluate the effectiveness of each educational approach along with different motivational strategies or practice environments to enhance pharmacists' practice behavior or patient outcomes.

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APPENDIX S1: Sample Questions

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