Health Science Reports

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Comparison of the Effect of Healthy Lifestyle Education Through Peer Groups and mHealth Application on the Self-Efficacy of Patients With Diabetes Mellitus: A Randomized Clinical Trial

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Received: 23 March 2024 | **Revised:** 10 January 2025 | **Accepted:** 16 February 2025

Funding: This study was supported by Aja University of Medical Sciences (Grant 69954).

Keywords: diabetes mellitus | education | lifestyle | self-efficacy | telemedicine

ABSTRACT

Background and Aims: Type 2 diabetes mellitus is a significant global public health issue. An unhealthy lifestyle can lead to this condition, but with the right education, we can prevent it. This study aimed to compare the effects of healthy lifestyle behaviors, education delivered through peer groups, and mHealth application on the self-efficacy of patients with diabetes mellitus.

Methods: This randomized clinical trial was carried out in 2022. Using purposive sampling, 135 patients with diabetes mellitus from two hospitals in Kermanshah, Iran, were recruited and assigned into three groups: peer education, virtual education through the mHealth application, and control. Peers with diabetes, whom the researcher trained, taught the patients of the peer education group four 35-min sessions in 2 days. With an application created for diabetes patients, the researchers taught the patients in the mHealth group in three 1-h sessions over 3 days. The individual characteristics and self-efficacy questionnaires were used to gather data.

Results: The mean self-efficacy score did not significantly differ between the three groups before the training ($p = 0.10$). However, a significant difference was observed after the training ($p < 0.001$). The mean self-efficacy score of patients in the peer education group (100.36 ± 15.9 vs. 106.87 ± 9.08, $p = 0.01$) and the mHealth group (100.80 ± 24.72 vs. 116.91 ± 10.67, $p = 0.02$) had a significant increase after training, while there was no significant difference in the control group (106.87 ± 9.08 vs. 105.60 ± 10.84, $p = 0.13$). The mHealth application was more effective than peer group training on the self-efficacy of patients with diabetes ($p < 0.001$).

Conclusions: The self-efficacy of patients with diabetes mellitus can be increased by healthy lifestyle training through peer education and mHealth application. However, the mHealth application was more effective compared to peer group education. Future studies should examine how education applications affect patients with other chronic diseases' sense of self-efficacy.

1 | Introduction

Five hundred and thirty-seven million people (20–79 years old) were estimated to have type 2 diabetes mellitus in 2021, according to a report by the International Diabetes Federation; this number is projected to rise to 643 million by 2030 and to 783 million by 2045 [1]. Over 60 million people in Europe had type 2 diabetes mellitus in 2020, according to the World Health Organization, and 1 in 10 Americans was estimated to have the disease in 2019 by the Centers for Disease Control and Prevention [2]. Diabetes is estimated to affect 14.15% of Iranians over the age of 18 in 2021, according to a report from the National Institute of Health Research of Iran [3].

There is evidence that lifestyle modification can prevent type 2 diabetes mellitus from spreading to high-risk populations and from progressing [4]. The previous studies emphasized the importance of lifestyle modification programs to manage diabetes mellitus [5]. These programs enhance lifestyle factors, such as nutrition, physical activity, stress management, and smoking [6–8].

It is crucial to implement educational and clinical interventions to increase patients' capacity to keep track of their own and their families' health [9]. Evidence shows that elevating one's level of self-efficacy enhances health. A study revealed that increasing self-efficacy enhances patients' capacity for health-related behaviors like weight loss [10]. Low self-efficacy is an important problem for diabetes patients' empowerment [11]. Self-efficacy is the belief that a successful treatment will produce the desired results [12]. Achieving goals, decreasing stress, and gaining more control over one's circumstances are all made possible by such an effective perspective [13]. One of the critical elements in achieving behavioral goals is self-efficacy [14].

Peer education is a potential method to raise the quality of care provided to diabetic patients [15]. In this method, motivated and educated diabetes patients help other diabetics manage their condition in a culturally appropriate way. Peer education is more dependent on patients with diabetes than medical experts, so it requires fewer resources than traditional approaches. It can succeed in environments with limited access to high-quality healthcare [16, 17].

The requirement to learn during specific and predetermined hours can cause a general limitation in learning, as evidence has shown that face-to-face instruction in the classroom causes a feeling of fatigue. However, inclusive independence in applying educational methods can boost general satisfaction and have positive consequences [18, 19]. These factors contribute to the poor attendance at face-to-face training sessions formally held for diabetic patients. It's essential to focus on offering more flexible training [20]. Mobile health (mHealth) applications are the growing utilization of educational software. Some studies have recommended new technologies, such as mobile apps, to inform patients with chronic diseases [21–24]. There is a chance to raise the quality of virtual education through mobile applications [25]. People worldwide increasingly use mobile applications to enhance their health [26]. The BankMyCell website estimates that 6.92 billion people will use mobile phones worldwide in 2023, accounting for 86.29% of the world's population [27]. Numerous mobile applications for health management are being developed. Applications for smartphones and tablets can give patients the necessary training by giving them pre-planned information [28]. mHealth applications have the potential to be effective in offering educational support and patient follow-up because they can provide people with current, clinically relevant, and targeted information [23, 29]. In this context, artificial intelligence (AI) can be important in using and delivering mHealth applications [30]. Patients with diabetes and those managing other chronic diseases both use these applications. The studies show that mobile applications affect diabetes patients' knowledge and behavior, blood sugar control, and self-care activities [31–33].

No comparable study comparing the effects of peer education and mHealth applications on diabetes patients was found in the researchers' reliable database searches. One innovation of the current research is to examine the impact of healthy lifestyle education in these self-directed and student-centered methods on patients' self-efficacy. So, this study aimed to compare the effect of healthy lifestyle behaviors education through peer groups and mHealth application using interactive virtual classes on the self-efficacy of patients with diabetes.

2 | Research Design and Methods

2.1 | Design

This three-group randomized clinical trial study was carried out in 2022 and was registered in the Iranian Registry of Clinical Trials (No. IRCT20210808052115N1; Date: October 6, 2021).

2.2 | Participants and Setting

Using the mean and standard deviation from a prior study [34], the sample size was estimated to be 41 for each group with a 95% confidence level and a 90% test power, and considering the probability of a 10% dropout rate, 45 participants were studied for each group.

Using the purposive sampling method, 135 diabetes mellitus patients who were admitted to two hospitals in Kermanshah, Iran, between August and December 2022 were recruited in the study and assigned into three groups: training by peer groups ($n = 45$), mHealth application ($n = 45$), and control ($n = 45$). Replacement randomization was used to divide patients into groups. Randomized blocks of six were used to assign patients to three groups randomly. First, the research assistant randomly assigned the letters A, B, and C to the groups (ABCCAB, BACCAB, ABCBAC, and CBAACB), unaware of the informed groups. This method bases the blocks on the week; the potential blocks were selected randomly. For example, the patients who were admitted to the hospitals in the first, second, and third weeks were included in the control group (A), peer education group (B), and mHealth application group (C), respectively. The blocking carried on in the same manner until the required sample size was reached.

Inclusion criteria include willingness to participate in the study, age between 21 and 75 years, and at least 6 months having passed since the diagnosis of uncontrolled type 2 diabetes mellitus based on a fasting blood sugar test index above 126 mg/dL [35]. Be literate and use a smartphone; ability to speak and read in Persian; have access to a smartphone and the internet and the ability to use them; the possibility of installing an application on a smartphone; have the possibility of making direct phone calls with the patient and his active family member; not suffer from cognitive disorders and physical disabilities; not needing diabetic foot surgery; lack hearing and vision impairment; and lack of education in medical sciences; and have no history of participating in diabetes education programs during the past 6 months. The exclusion criteria were new physical disorders that make it harder for the patient to care for themselves, reluctance to continue participating in the study, and failure to use the application.

2.3 | Data Collection

An individual characteristics questionnaire (gender, education level, income level, head of family, person caring for the patient, hypertension, hyperlipidemia, kidney disease, unhealed wound, and the most important disease of first-degree relatives) and diabetes management self-efficacy scale (DMSES) were used to gather the data. This questionnaire contains 19 items and is scored on an 11-point Likert scale from "*I can't at all*" (score = zero) to "*I definitely can*" (score = 10).

A higher score indicates higher self-efficacy. A score of 0–66 represents low self-efficacy, moderate self-efficacy is 66–133, and high self-efficacy is 130–190. This questionnaire has four dimensions, including nutrition (9 items), physical activity (3 items), blood sugar (3 items), and medication (4 items), which are based on exploratory factor analysis. The questionnaire's Cronbach's α in the study by McDowell et al. was 0.91 [36]. Previous studies have verified the validity and reliability of the Persian version of this questionnaire [37, 38]. In this study, the DMSES's Cronbach's α was 0.82.

2.4 | Intervention

Based on a list of patients who visit two hospitals, the researcher chose three patients as peers to train subjects. None of the chronic complications of diabetes, such as kidney failure, blindness or severe vision loss, diabetic foot ulcers, or amputation, affected these patients. And they had glycosylated hemoglobin below 6.5. In a 2-h lecture and face-to-face session, the researcher instructed the peers using educational content according to the educational needs of patients with type 2 diabetes mellitus. Gifts were also considered for the peers given to them after the training sessions.

The patients in the three groups first filled out questionnaires. The peer group patients were then split into three groups of 15, and each group received a phone call inviting them to the training sessions. Then, peers trained each group face-to-face during four 35-min sessions in 2 days, and the researcher watched over them. Peers expressed their experiences and advised on how to boost diabetic patients' self-efficacy at these meetings.

The mHealth application group's patients received training on installing and using the social messenger application and the mHealth application developed for diabetic patients and information on increasing the patients' self-efficacy. In social messenger, questions could be posed and responded to. A message regarding the start of the training course and instructions on how to participate in the training course was sent to each member after confirming that the application had been correctly installed on the patient's mobile phone. People were given training content via social messenger in three sessions every other day for a week, using PowerPoint slides with sound, video clips, text, and audio files. Utilizing their usernames, training session attendance for patients was managed. The researcher used social messenger to remind the patients weekly to use the application's training content. Participants had no trouble using the training content in the application prepared for diabetic patients. A better understanding of diabetes, how to diagnose diabetes, diabetes symptoms, diabetic lifestyle, mental health, spiritual health, promoting physical activity, diet, oral diabetes medications, and insulin therapy are all covered in the training content of this application. Four Aja University of Medical Sciences nursing faculty members approved the application's technical and training components. Both training groups received the same educational content.

A login user and password were considered for the users of the mHealth application group to prevent contamination bias between the patients of the three groups and the lack of access for other groups to the application's training content until the conclusion of the study.

The three groups' patients can access the physicians' and nurses' routine training or the hospital's educational assistance methods. The patients from all three groups were reevaluated using the diabetic patients' self-efficacy questionnaire 2 months later. Figure 1 depicts the study process. Out of 168 diabetic patients, 20 did not meet the inclusion criteria, and five declined to participate. The remaining 143 patients were assigned into three groups: a peer education group ($n = 48$), a mhealth application group ($n = 48$), and a control group ($n = 47$). One patient in the peer education group was excluded from the study because they were hospitalized, and two others were excluded because they missed class. Due to a smartphone problem, one patient from the mHealth application group was excluded from the study. One patient was excluded from the mHealth application group due to surgery, and another was excluded due to an absence from the virtual class. Two patients in the control group were excluded from the study because they were hospitalized. Finally, 45 patient records from each group were examined (Figure 1).

2.5 | Data Analysis

For doing statistical analysis, the Statistical Package for the Social Sciences (SPSS) software version 18 (SPSS Inc. Chicago, IL, USA) was used. Descriptive statistical tests (mean, standard deviation, frequency, and percentage) were used for individual characteristics. The Kolmogorov–Smirnov test was used to determine whether the data distribution was normal. The χ^2, Fisher's exact test, independent *t*-test, and intergroup

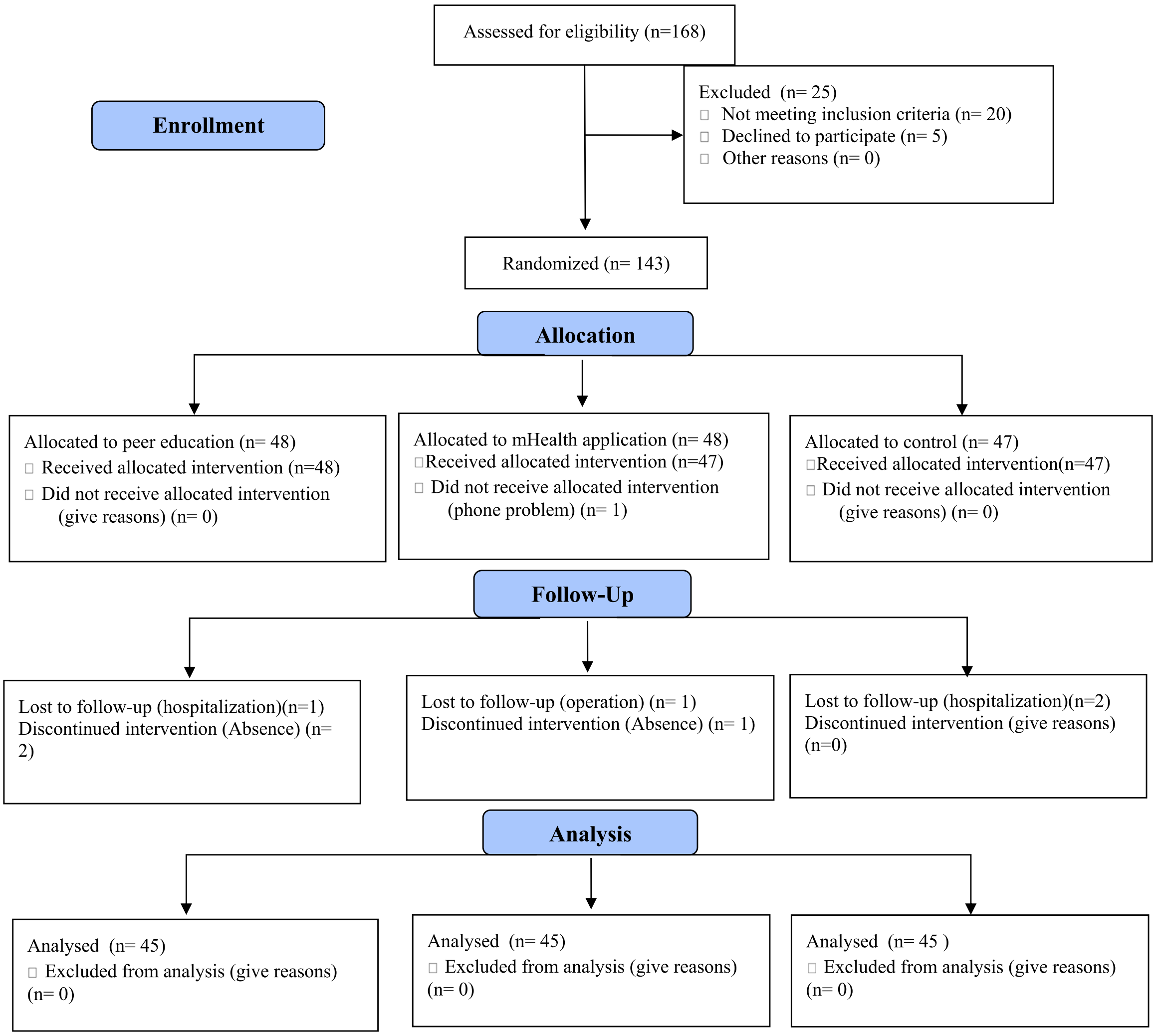

FIGURE 1 | The study process.

comparisons were conducted using one-way analysis of variance (ANOVA), one-way analysis of covariance (ANCOVA), and post hoc tests. Intra-group comparisons were performed using the paired *t*-test. Web Power Statistical Power Analysis Online was used to calculate effect sizes. The test's significance level was set at $p < 0.05$. The statistical analyst was blinded to the allocation of samples to different groups.

3 | Results

The mean age of the patients was 40.22 ± 11.50 (21–65 years), and a mean of 51 ± 42.04 (9–346 months) had been diagnosed with diabetes. The majority of patients (53.3%) were men with education levels above elementary school (67.4%), and about 60% acknowledged having enough income. Most (40.7%) lived with their spouses and kids, and more than half (56.3%) were family heads. The majority of patients had high blood cholesterol (43), as opposed to high blood pressure (54.1%), kidney disease (58.5%), vision loss, and unhealed wounds (63%). Diabetes (48.9%) was the most prevalent disease among first-degree relatives. The results revealed that the patients' individual characteristics did not significantly differ between the three groups ($p < 0.05$) except age, diabetes duration, blood sugar, and BMI ($p < 0.05$) (Table 1).

Patients in the peer education group had significantly higher self-efficacy scores overall ($p = 0.01$), scores of physical activity ($p = 0.001$), and blood sugar ($p = 0.02$) after the training compared to before the training. The scores for nutrition ($p = 0.08$) and medication ($p = 0.08$) did not differ significantly before and after training.

When compared to before the training, patients in the mHealth application group's total self-efficacy score ($p = 0.02$) and the dimensions of nutrition ($p < 0.001$), and physical activity ($p = 0.007$) increased significantly. The dimensions of medical care ($p = 0.94$) and blood sugar ($p = 0.11$) did not differ substantially before and after training.

Before and after training, there was no significant difference in the control group's patients' overall self-efficacy score ($p = 0.13$), dimensions of nutrition ($p = 0.17$), physical activity ($p = 0.57$), blood sugar ($p = 0.82$), and medication ($p = 0.13$) (Table 2).

There was no significant difference between the three groups before the intervention for the total score of self-efficacy ($p = 0.10$), nutrition ($p = 0.91$), or medication dimensions ($p = 0.08$), but there was a significant difference between the three groups for physical activity ($p = 0.015$), and blood sugar dimensions ($p = 0.01$).

TABLE 1 | Comparison of individual characteristics of patients with diabetes mellitus in peer education, mHealth application, and control groups.

Groups Individual characteristics		Peer education *f* (%)	mHealth application *f* (%)	Control *f* (%)	Statistic	df	*p*-value
Gender	Male	21 (46.7)	26 (57.8)	25 (55.6)	1.25[a]	2	0.820
	Female	24 (53.3)	19 (42.2)	20 (44.4)			
Level of education	Informal literacy	6 (13.3)	2 (4.4)	4 (8.9)	−7.448[a]	4	0.114
	Elementary	12 (26.7)	6 (13.3	14 (31.1)			
	Elementary <	27 (60)	37 (82.2)	27 (60)			
Income	Low	3 (14.6)	11 (24.4)	3 (6.7)	6.12[a]	4	0.192
	Moderate	25 (55.6)	23 (51.1)	31 (68.9)			
	High	13 (28.9)	11 (24.4)	11 (24.4)			
Head of family	The patient	22 (48.9)	27 (60)	27 (60)	1.84[a]	4	0.800
	Spouse	21 (46.7)	16 (35.6)	17 (37.8)			
	Children	2 (4.4)	2 (4.4)	1 (2.2)			
A person caring for the patient	Single	6 (13.3)	3 (6.7)	1 (2.2)	28.67[b]	10	0.236
	Wife/husband	24 (53.3)	10 (22.2)	14 (31.1)			
	Wife/husband and children	13 (28.9)	25 (55.6)	17 (37.8)			
	Children	2 (4.4)	0 (0)	3 (6.7)			
	Parents	0 (0)	6 (13.3)	10 (22.2)			
	Others	0 (0)	1 (2.2)	0 (0)			
Hyperlipidemia	Yes	22 (48.9)	19 (42.2)	17 (39.5)	0.911[a]	4	0.445
	No	17 (37.8)	20 (44.4)	20 (46.5)			
	Unknown	6 (13.3)	6 (13.3)	6 (14)			
Hypertention	Yes	22 (48.90	16 (35.6)	13 (29.5)	3.84[a]	4	0.288
	No	20 (44.40)	26 (57.8)	27 (61.4)			
	Unknown	3 (6.7)	3 (6.3)	4 (9.1)			
Kidney disease	Yes	11 (24.4)	3 (6.7)	16 (35.6)	33.794[a]	6	0.366
	No	17 (37.8)	40 (88.9)	22 (48.9)			
	Unknown	16 (35.6)	2 (4.4)	7 (15.6)			
Unhealed wound	Yes	6 (13.3)	5 (11.1)	9 (20)	14.03[a]	4	0.273
	No	21 (46.7)	34 (75.6)	30 (66.7)			
	Unknown	18 (40)	6 (13.3)	6 (13.3)			
The most important disease of first-degree relatives	Blood pressure	4 (9.1)	8 (25.8)	10 (22.2)	12.11[b]	10	0.396
	Diabetes melitus	28 (63.6)	46 (51.6)	22 (48.9)			
	Hyperlipidemia	8 (18.2)	6 (19.4)	10 (22.2)			
	Kidney disease	4 (9.1)	0 (0)	2 (4.4)			
	Unhealed wound	0 (0)	0 (0)	1 (2.2)			
	Retinopathy	0 (0)	1 (3.2)	0 (0)			

Abbreviation: *f*, frequency.
[a] χ^2.
[b] Fisher's exact test.

A one-way ANCOVA was conducted to determine a statistically significant between three groups on total score of self-efficacy controlling for age, diabetes duration, blood sugar, and BMI. There was a significant effect of education type on total score of self-efficacy after controlling for these cofounders ($F = 6.435$, $df = 3$, $p < 0.001$). As well as, there was a significant difference between the three groups in terms of the dimensions of nutrition ($p = 0.003$), physical activity ($p < 0.001$), blood sugar

TABLE 2 | Comparison of the mean scores of self-efficacy dimensions in the peer education, mHealth application, and control groups.

Dimensions	Stage	Peer education mean (SD)	mHealth application mean (SD)	Control mean (SD)	*F*	df	*p*-value
Nutrition	Pre-intervention	48.58 (9.68)	49.53 (11.71)	49.18 (9.58)	0.098[a]	2	0.907
	Post-intervention	51.04 (6.11)	54.93 (5.90)	50.51 (7.34)	6.241[a]	2	0.003
	Paired *t*-test statistics, df, *p*-value	$t = -1.771$ df = 44 $p = 0.083$	$t = -3.928$ df = 44 $p = 0.001$	$t = -1.395$ df = 44 $p = 0.170$			
Physical activity	Pre-intervention	14.22 (3.44)	16.76 (4.95)	16.02 (4.03)	4.364[a]	2	0.015
	Post-intervention	15.89 (2.30)	18.31 (2.95)	16.24 (2.39)	45.492[b]	3	0.001
	Paired *t*-test statistics, df, *p*-value	$t = -3.755$ df = 44 $p = 0.001$	$t = -2.819$ df = 44 $p = 0.007$	$t = -0.573$ df = 44 $p = 0.570$			
Blood sugar	Pre-intervention	15.36 (4.08)	17.71 (4.66)	15.71 (2.91)	4.637[a]	2	0.011
	Post-intervention	16.62 (2.47)	18.78 (2.29)	15.67 (2.65)	37.910[b]	3	0.001
	Paired *t*-test statistics, df, *p*-value	$t = -2.438$ df = 44 $p = 0.019$	$t = -1.622$ df = 44 $p = 0.112$	$t = 0.230$ df = 44 $p = 0.819$			
Medication	Pre-intervention	22.20 (4.98)	24.80 (7.70)	22.38 (4.86)	2.641[a]	2	0.075
	Post-intervention	23.31 (2.68)	24.89 (3.25)	23.18 (3.31)	4.261[a]	2	0.016
	Paired *t*-test statistics, df, *p*-value	$t = -1.819$ df = 44 $p = 0.076$	$t = -0.08$ df = 44 $p = 0.936$	$t = -1.53$ df = 44 $p = 0.133$			
Self-efficacy	Pre-intervention	100.36 (15.19)	100.80 (24.72)	106.87 (9.08)	2.288[a]	2	0.105
	Post-intervention	106.87 (9.08)	116.91 (10.67)	105.60 (10.84)	16.288[a]	2	0.001
	Paired *t*-test Statistics, df, *p*-value	$t = -2.67$ df = 44 $p = 0.011$	$t = -2.451$ df = 44 $p = 0.018$	$t = -1.525$ df = 44 $p = 0.134$			

Abbreviation: SD, standard deviation.
[a]One way-ANOVA;
[b]ANCOVA.

($p < 0.001$), and medication ($p = 0.02$) after the intervention (Table 2).

The post hoc test revealed significant differences between the mHealth application group and the peer education group in total self-efficacy ($p = 0.001$), nutrition ($p = 0.005$), physical activity ($p = 0.001$), and blood sugar ($p = 0.001$) dimensions following the intervention. The score of the mHealth application group was significantly higher than that of the peer education group. However, there was no difference in the medication dimension ($p = 0.84$).

Also, after Bonferroni's correction and considering the significance level > 0.017, the independent *t*-test showed that the patients in the mHealth group had higher self-efficacy than the peer education group after the intervention ($p < 0.001$).

Self-efficacy scores and their dimensions were not significantly different between the peer education and control groups ($p > 0.05$).

After receiving training in healthy lifestyle behaviors, patients in the mHealth application group showed significant improvement in their total self-efficacy ($p = 0.001$), nutrition ($p = 0.002$), physical activity ($p = 0.001$), blood sugar ($p = 0.001$), and medication ($p = 0.01$) scores compared to the control group (Table 3).

The findings showed that after control the effect of cofounders the overall effect size of both training methods on patients' self-efficacy was 0.4947.

4 | Discussion

The current study aimed to compare the effects of healthy lifestyle training through peer groups and mHealth application on the self-efficacy of diabetic patients. The findings indicated that peer group and mHealth application methods improved total self-efficacy scores in patients with diabetes. The overall effect size of both training methods on patients' self-efficacy was moderate in physical activity, blood sugar dimensions, and total score of self-efficacy. The mHealth application group also experienced a more significant increase in self-efficacy than the peer group and improved nutrition, physical activity, and blood sugar dimensions.

TABLE 3 | Comparison of the mean difference of self-efficacy dimensions of patients with diabetes mellitus after intervention in the peer education, mHealth application, and control groups.

Dimensions	Groups		Mean difference	Standard error	*p*-value
Self-efficacy	Peer education	mHealth application	−10.044	2.156	0.001*
		Control	1.267	2.156	0.558
	mHealth application	Peer education	10.044	2.156	0.001*
		Control	11.311	2.156	0.001*
Nutrition	Peer education	mHealth application	−3.889	1.367	0.005*
		Control	0.533	1.367	0.697
	mHealth application	Peer education	3.889	1.367	0.005*
		Control	4.422	1.367	0.002*
Physical activity	Peer education	mHealth application	−2.422	0.614	0.001*
		Control	−0.356	0.614	0.563
	mHealth application	Peer education	2.422	0.614	0.001*
		Control	2.067	0.614	0.001*
Blood sugar	Peer education	mHealth application	−2.156	0.490	0.001*
		Control	0.956	0.490	0.053
	mHealth application	Peer education	2.156	0.490	0.001*
		Control	3.111	0.490	0.001*
Medication	Peer education	mHealth application	−1.578	0.652	0.017*
		Control	0.133	0. 652	0.839
	mHealth application	Peer education	1.578	0. 652	0.017*
		Control	1.711	0. 652	0.010*
Medication	Peer education	mHealth application	−1.578	0.652	0.017*
		Control	0.133	0. 652	0.839
	mHealth application	Peer education	1.578	0. 652	0.017*
		Control	1.711	0. 652	0.010*

*$p < 0.05$.

Huang et al. demonstrated that a multimedia diabetes training program can enhance patient satisfaction with health education, knowledge of diabetes and insulin injection, insulin injection skills, and self-efficacy in insulin injection [39]. Huang et al.'s study and the current study demonstrated the significant impact that virtual education has on the self-efficacy of patients with type 2 diabetes mellitus. Goodarzi et al. showed that type 2 diabetes patients' self-efficacy and HBA1C were positively affected by distance education via text messaging on mobile phones [40]. The findings of the previous study, which were in line with those of the current study, demonstrated the significant impact of virtual and mobile phone-based education on the self-efficacy of type 2 diabetes mellitus patients.

Yang et al. demonstrated that patients with type 2 diabetes mellitus can improve their glucose and blood cholesterol control and self-management behaviors by combining basic training and peer education [41]. The previous study's findings followed those of the current study and demonstrated the significant impact of peer education on the lifestyle of type 2 diabetes mellitus patients. According to Abd-alrazaq et al. and the present study, using an application is more effective and practical for health workers and patients to communicate [42].

The results of Vakilian et al.'s study also demonstrated that patients with diabetic foot ulcers can improve self-efficacy, lifestyle, and its dimensions through education based on Pender's health promotion model [43]. According to Pefbrianti et al., peer education positively affects cancer patients' self-efficacy [44], which aligns with the current study's findings that education significantly affects patients' self-efficacy.

Patients with diabetes need prompt, integrated interventions to promote self-care management and receive support training and medical equipment [45]. To reduce face-to-face training in such circumstances, it is necessary to use online or virtual education approaches [46].

Because in the studies, only the self-efficacy score was examined, and the results related to the dimensions were not reported, it was impossible to compare the results of the present study with the existing research results.

The results showed that mHealth application was superior to peer group training for diabetes patients' self-efficacy. This finding aligns with previous research that highlights the advantages of mHealth technologies in fostering self-management behaviors and empowering patients through tailored, accessible, and flexible educational content [47]. However, cultural and language differences may impact the effectiveness of mHealth applications, necessitating adaptations to suit diverse patient needs [48].

4.1 | Ethics Approval and Consent to Participate

The Aja University of Medical Sciences Research Ethics Committee approved this study (No. IR.AJAUMS.REC.1400.131). In this study, the guidelines of the Helsinki Declaration were followed. For example, a detailed explanation of the study's objectives and the participant's role in it was provided to them at the outset, and their written informed consent approved by the Research Ethics Committee of Aja University of Medical Sciences was obtained. The study respected the participants' right to withdraw voluntarily from it at any time and the confidentiality of the data. In addition, the ethics rules of the Committee on Publication Ethics publications were adhered to.

5 | Conclusions

The results of the study demonstrated that peer group training and mHealth application had a positive impact on the self-efficacy of diabetic patients. The educational interventions also helped patients' physical activity, nutrition, blood sugar control, and medication. The results demonstrated that the mHealth application was more effective at enhancing the self-efficacy of diabetes patients than peer education. Both methods are self-directed and student-centered. However, mHealth can be used at any place and time and can be used repeatedly to master the material. Future studies suggested conducting similar studies on using AI in managing chronic diseases.

5.1 | Limitations

One potential limitation of this study is the possibility of educational material sharing among the three groups. To address this, the mHealth application group was secured with a dedicated user login and password. Another limitation is the relatively small sample size and the reliance on self-reported methods for data collection. Additionally, some variables were not homogeneous before the intervention; however, their confounding effects were managed using the ANCOVA test.

Author Contributions

Azad Fatahi: writing – review and editing, visualization, validation, methodology, writing – original draft, funding acquisition, investigation, conceptualization, software. **Seyedeh Azam Sajadi:** resources, supervision, data curation, conceptualization, writing – original draft, methodology, validation, visualization, writing – review and editing. **Zahra Farsi:** data curation, formal analysis, resources, supervision, conceptualization, investigation, funding acquisition, writing – original draft, writing – review and editing, visualization, validation, software, methodology. **Alireza Malekshahi:** project administration.

Acknowledgments

This study was approved by the Aja University of Medical Sciences. The authors thank the administrators of the study setting, Aja University of Medical Sciences, and the patients who participated in this study. This study was supported by Aja University of Medical Sciences (Grant Number: 69954, 8 December 2020). In this study funder had no involvement in designing, data collection and analysis, interpretation of data, writing the paper, and the decision to submit it for publication.

Consent

The authors have nothing to report.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

Transparency Statement

The lead author Seyedeh Azam Sajadi affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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