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The impact of Multimedia Software Support on the Knowledge and Self-Care Behaviors of Patients with Type 2 Diabetes: a Randomized Clinical Trial

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ABSTRACT

Introduction: Education is the most effective and economical part of diabetes treatment. The purpose of this study was to investigate the effect of a training program with multimedia software on the knowledge and self-care behaviors of patients with type 2 diabetes.

Methods: This study was a randomized controlled clinical trial in which 60 patients referred to diabetes clinic at Arak city were divided randomly into experimental (n=30) and control (n=30) groups. The instruments for collecting data were "Summary of Diabetes Self-Care Activities questionnaire" and "knowledge of self-care in patients with diabetes". Data were collected before and 2 months after the intervention in the both groups. Educational program with equal content was applied for both experimental group (self-care program with multimedia software support) & control group (lecture and presentation with PowerPoint). Data analysis was done using SPSS Ver.13.

Results: Implementation of the self-care program with multimedia software support resulted in improvements in patients' self-care behaviors in the experimental group, whereas these behaviors had not significant changes in the control group after eight weeks. There was a significant difference in the mean score of knowledge in both the experiment and control groups before and after the intervention.

Conclusion: Considering beneficial effects of training program with multimedia software support on the knowledge and self-care behaviors and the importance of this issue, suggested that the patients preferably provide terms of use of educational software for themselves.

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Introduction

Diabetes is included a group of metabolic diseases characterized by high blood glucose levels, which happens as a result of insulin resistance or impaired insulin secretion in the body.¹ Disturbance in the metabolism of carbohydrates, proteins and fats deficiency or lack of insulin leads to damage to various organs and reduce the life span of patient.² In 2010, the number of patients with type 2

diabetes was approximately 200 million people worldwide which is projected to rise to 266 million people within 25 years.³ According to the statistics, the percentage of patients with this disease is reported to be between 1% and 4% in the general population and 5% and 10% in individuals older than 40.⁴

Regarding the epidemic of diabetes mellitus and its high mortality and morbidity, this disease has become a concern at public health in the world.^{5,6}

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The amount of knowledge on diabetes patients has significant role in controlling this disease and promoting self-care activities.⁷ According to the Orem's definition, self-care is a regulatory learned function in humans that is based on the people's ability to take care of themselves.⁸

Lack of awareness of related behavior to self-care, incorrect information or lack of understanding of treatment impact on patient's adherence to the treatment. However, awareness by implementing education programs has positive effects on the lifestyle and outcome of the disease.⁹ Jalilian, citing Kamel *et al.*, highlights the importance of knowledge of self-care behaviors.¹⁰

People with chronic diseases such as diabetes need self-care behaviors during their lifetime¹¹ and it includes the most important activities such as healthy and balanced diet, following-up of medical therapy, monitoring glucose levels to adjust the diet, activity level and prescribed medication.¹² Using appropriate strategies about lifestyle and self-care are the key elements for the prevention of diabetes that requires comprehensive educational interventions.^{13,14} In this regard, various educational programs is provided around the world to empower and present adequate skills of self-care to patients.¹⁵⁻¹⁷ However, the main challenge of training programs is selecting the interventions which has long term effects, because most programs have a positive impact in the short or medium time.¹⁸

One of the major innovation in education is E-learning. This unique approach allows individuals to learn anywhere they like.¹⁹ Using computer training programs help learners who have a limited time for training and consultancy. Use of technology-based approaches may be has greater value in people with diabetes, elderly and people who have complicated problems. Multimedia programs have lots of advantages such as benefiting from contexts and audio or video elements like

videos, icons and graphic.²⁰ Computer-based training programs may reduce the workload of busy service providers and has limited time for helpful consultancy and training.²¹ In addition, these programs enable people to benefit from information according to personal needs, profits and competency and also evaluation of knowledge for enrichment of goals.²⁰ It is also possible to use computer technology to provide constant support and help to facilitate the care of patients.²²

The study of Khandan *et al.*, and Noohi *et al.*, show that E-learning is effective on operations of patients suffering from diabetes type II,^{23,24} and knowledge and self-care attitude.²⁴

The results of one qualitative study (2014) showed that diabetic patients had limited training to applying technology in managing their disease and require interventions based on computer technology for their education management strategy.²² According to the findings of previous study and with regard to the management of diabetes that is a challenge for patients and health care professional,²⁵ one of the most important and integral component of managing diabetes at any age is training patients on self-care activities.²⁶

Implementation of new training techniques such as the use of educational software which is freely available, may have positive impact on patient's knowledge on managing diabetes. Therefore, by believing that traditional classes are not effective,²⁷ the present study was performed to evaluate the effectiveness of training programs with multimedia software support on knowledge and self-care behaviors of diabetic patients.

Materials and methods

This study was a randomized controlled clinical trial. The study population included all patients with diabetes type II, who had referred to diabetes clinic of Arak city and met inclusion criteria. An informed consent

form was obtained from all candidates after explanation of the goals and plans of the study.

Participants were randomly divided into two groups, experiment (n=33) and control (n=34) by random number table. The sample size was obtained through conducting a pilot study and it was evaluated using the minimum sample size formula for making comparison means between two independent sample populations. Using mean and standard deviation of variables for groups and possible 10% attrition rate, the required sample size for the Alpha 0.05 and test power of 0.8, 33 patients were calculated in each group.

Inclusion criteria included: patients with diabetes type II, aged between 20 to 60 years, personal or one of the family members access to computer for using software, ability to read, ability of performing self-care, and lack of previous use of multimedia training approach for diabetes. Exclusion criteria included: unwillingness to continue participation in the study, failure to complete the questionnaire, and lack of use of the software. Seven patients don't complete the questionnaire, 2 month after clinical trial. Finally, 30 patients in experimental and 30 patients in control group completed the study.

A one-day training course was performed in control group under the title of "Self-care in diabetes patients". Educational program with equal content was applied for both groups. Time schedule of this program was 180 minutes. Educational methods were lecture and presentation with PowerPoint program. The experimental group was trained with self-care program.

Self-care program with an educational software support was applied in experimental group with following steps:

Designing & Determining the validity of multimedia software:

The title of multimedia software was "Self-care in diabetes patients". The content of

educational software included an introduction on diabetes, diabetes & sport, diabetes & blood sugar control, diabetes & digestion and diabetes and foot care. Firstly the researcher prepared required items for determining the validity of software by the use of relevant books and papers about training of diabetes patients. Some images, contents, animation and audio were used for making this software. For ensuring about scientific validity of content, 5 members of Nursing Scientific Board checked the software. Also 3 diabetes patients received the same software to determine their understanding of educational issues. Finally all required changes were made accordingly.

Group training:

There were 2 group training sessions with a 2-week intervals. All group training sessions include 10-15 patients and hold at Health Center of Markazi province.

First session: The educational content included introduction of diabetes, diabetes & sport, diabetes & blood sugar control, diabetes & digestion and diabetes and foot care. All questions from patients were answered. The first session was about 180 minutes. At the end, all patients received their self-care software. They were requested to use their self-care software at least once a week after the educational program. In case of any question, they were free to call us for telephone consultancy. So, they received the required telephone numbers.

Second session: After assessing the patient's condition and their self-care activities and receiving suitable feedback, all questions of patients about their self-care necessities were answered in this session. Also patients were free to explain their experiences and feelings. Time schedule of second session was averagely 90 minutes.

To determine the level of knowledge of self-care of patients with diabetes, a researcher made questionnaire was used. The questions were developed based on a

review of literature. It consisted 34 questions and 4 subscales including diet (11 questions), exercise (5 questions), blood Sugar control (11 questions) and Foot Care (7 questions). The questionnaire was given to 8 of the Faculty of Nursing and 3 patients in order to determine its content validity and after considering their comments, the questionnaire distributed among 20 patients with diabetes and calculated reliability with Cronbach's alpha was 0.74. For easy interpretation of the findings, the total score and subscales were calculated as percentage. The minimum and maximum score was 0 and 100, respectively. Higher scores indicated higher levels of knowledge.

To determine the self-care activities of patients with diabetes, The Summary of Diabetes Self-Care Activities (SDSCA) questionnaire was used. This questionnaire was designed by Toobert *et al.*, Regarding the purposes of this study, some parts of the questionnaire was used which was consisting of 14 questions and 4 subscales including; diet (5 questions), exercise (2 questions), blood sugar testing (2 questions) and foot care (5 questions).²⁸ For validity, the questionnaire was translated into Persian and then was back translated to English. During the process, problems and ambiguities has been identified and resolved in translation. The results of the study of Ghaneie *et al.*, in Iran showed that its reliability by using test-retest method was $r = 0.71$.²⁹ In the present study, Cronbach's alpha was 0.70.

The evaluation is parameterized in days of the week, on a scale of 0 to 7, corresponding to the behaviors related to the last seven days. The mean scores of questions were calculated for each subscale.²⁸

Data were collected before and 2 months after the intervention in the both groups. To complete the questionnaire, the patients of both groups were called to refer to diabetes clinic two month after clinical trial.

Statistic data were analyzed by SPSS Ver 13 software and using descriptive statistics

(Absolute and estimated frequency, mean and standard deviation) and inferential statistics. Independent t test was applied for comparing of demographic variables between both groups in term of age and duration of disease. Chi-square test was used for gender and literacy level.

Independent t-test was used for comparing the mean difference between knowledge scores and self-care activities between pre- and post-intervention in both control and experiment groups. Paired t-test was used in comparing the mean score of self-care activities in each group before and after intervention. It should be noted that the results of the Kolmogorov-Smirnov test showed that all of the study variables had a normal distribution.

The present study was approved by the Ethics Committee of Arak University of Medical Sciences, Arak, Iran, and (No.92-151-7).

This study was conducted after obtaining an informed consent from all subjects participating in the study.

Results

The majority of participants were female ($n = 39, 65\%$). The mean (SD) of age was 51.64 ± 12.29 year. The mean (SD) of duration of illness was $8.01 (6.82)$ year. Results of independent t-test didn't show any significant difference in comparing the mean age ($P=0.19$) and duration of the disease ($P= 0.35$) between the experimental and control groups. Also, there wasn't significant differences in term of gender ($P =0.17$) and educational level ($P=0.14$) between control and experimental groups.

The results of paired t-test showed that there was a significant difference in both experimental and control groups in mean scores and all subscales of knowledge between pre- and post-intervention (except the subscale exercise in the control group) (Table 1).

The results of paired t-test showed that there was a significant improvement in

mean of the total score and all subscales of self-care activities except for the blood sugar testing (P=0.64) in the experimental group after the intervention, as compared to before intervention. While there was no significant difference in total mean score and all subscales self-care activities except for foot care (P=0.028) in the control group after eight weeks, as compared to before intervention (Table 2).

There was not statistically significant difference between experimental and control groups in comparing the differences of mean score of knowledge between before and after intervention (P=0.35). But, there were significant differences between experimental and control groups in comparing the difference mean scores of self-care activities between before and after intervention (P=0.02) (Table 3).

Table 1. Comparison of score mean of knowledge of self-care before and 2 months after the intervention in control and experimental groups

Group Subscales	Experimental			Control		
	Before Mean (SD)	After* Mean (SD)	Paired t-test result	Before Mean (SD)	After* Mean (SD)	Paired t-test result
Diet	61.21 (18.01)	81.51 (16.27)	P<0.0001	65.75 (12.56)	79.09 (16.21)	P=0.001
Exercise	38 (19.89)	60.66 (17)	P<0.0001	44.66 (20.80)	54 (22.98)	P=0.06
Blood sugar control	66.06 (22.64)	82.72 (21.53)	P=0.009	66.06 (20.94)	80.60 (18.13)	P=0.007
Foot care	42.38 (23.27)	66.19 (24.16)	P<0.0001	38.57 (21.60)	65.71 (23.30)	P<0.0001
Total score	51.91 (15.02)	72.77 (15.33)	P<0.0001	53.76 (10.83)	69.85 (13.45)	P<0.0001

Table 2. Comparison of score mean of self-care activities before and after the intervention in control and experimental groups

Group Subscales	Experimental			Control		
	Before Mean (SD)	After* Mean (SD)	Paired t-test result	Before Mean (SD)	After* Mean (SD)	Paired t-test result
Diet	3.26 (1.41)	4.47 (1.17)	P<0.0001	3.77 (1.43)	4.31 (1.54)	P=0.14
Exercise	2.11 (2.06)	3.13 (2.11)	P=0.003	2.90 (2.46)	2.83 (2.07)	P=0.87
Blood sugar control	1.35 (1.40)	1.51 (1.78)	P=0.64	2.06 (2.007)	1.85 (1.79)	P=0.48
Foot care	3.36 (1.52)	4.18 (1.22)	P=0.003	4.006 (1.57)	4.46 (1.62)	P=0.028
Total score	3.36 (1.52)	4.18 (1.22)	P=0.003	3.18 (0.95)	3.36 (0.92)	P=0.35

*2 months after intervention

Table 3. Comparison of the difference mean scores of variables between experimental and control groups

Variables	Experimental group Difference Mean (SD)	Control group Difference Mean (SD)	Independent t-test result
knowledge	20.86 (22)	16.08 (17.06)	0.35
Self-care	0.80 (1.03)	0.17 (1.03)	0.02

Discussion

The results of this study showed that patients in both experimental and control groups were middle-aged and their mean duration of illness showed that this disease is chronic in nature; therefore, they are in greater need for more information on their disease and effective methods of self-care.

According to the Winkelman's view, diabetes has a complicated nature, with a

gradual development, and unpredictable relapses and recoveries periods, which due to its chronic course, entails the patient's greater involvement in the self-care program.³⁰ In the present study, women composed the majority of patients in both experimental and control groups. Similar studies have shown that the incidence of Type 2 diabetes is rising among female populations.³¹ The results of the present study are also indicative of changes in the

scores of study variables in experimental and control groups. This showed the positive impacts of education on the patients.

This study was done to evaluate the effectiveness of training programs, by using multimedia software on knowledge and self-care behaviors in diabetic patients. The results showed that training can improve patient knowledge (experimental and control). This result is in line with other studies which support the positive impact of education on raising awareness of diabetes.³²⁻³⁴ Heinrich et al., studied the impact of self-management training program based on web on patients with diabetes type II. The intervention resulted in significant increase in knowledge of patients, and users satisfied with the content and credibility of the program.³⁵ In another study by Kandula et al., study, multimedia training program also caused a significant increase in knowledge scores of patients with any level of education. However, patients with inadequate literacy could less learn significantly as compared to those who were literate enough.³⁶ According to a systematic review 16 studies from 19 trial studies showed the positive effect of computer using on diabetic patients.³⁷

In this study, the self-care behaviors were also investigated because of increasing knowledge and improving health behavior change is not sufficient to conclude. Several studies have been done in Iran and abroad on self-care behaviors in patients with type 2 diabetes. Considering the results indicating the weak performance of the patients on self-care behaviors and, eventually, the possibility of the incidence of undesirable side effects and outcomes, all of these studies unanimously agree on the need for making lifestyle modifications for improving self-care behaviors.³⁸⁻⁴⁰

The results showed that the training can be effective on care activities of patients in the experimental group. However, there wasn't significant difference in the results of

regular tests after training (lecture and slide presentation) in the control group. This finding could indicate an application of the training method used in experimental group that are displayed high potential for enhancing the lifestyle and self-care behaviors.

Also, due to the lack of a significant difference in the mean score of knowledge before and after the intervention in both groups, the use of educational software as an effective strategy for teaching could lead to greater balance in the visual and auditory learning and by learning and implementing the recommendations of care achieved more improvements in care.

Clinical benefits of computer-based diabetes education are one of the findings of several studies. Glasgow et al., found that patient-centered interventions and computer technology could improve the problems of diabetic patients in the areas of quality of life, depression, fat and HbA1c.⁴¹ In another study in 2006, he concluded that short-term periods of interfere by the help of computer and further feedbacks, designed goals, problem solving and consistency of health consultants may lead to a significant reduction in high-fat regimes and weight.⁴² The results of these studies were consistent with the findings of this study.

Optimal use of educational programs and strategies is necessary for type 2 diabetic patients. We believe that health education interventions must incorporate strategies that can improve retention of health information and engaging patients in long-term learning.

Norris et al showed that implementing of e-education programs, due to increased self-care and patient involvement in their care, was a good way to teach these patients.⁴³

Khan et al., also indicated the impact of multimedia educational program on self-management performance on diabetic patients, achieved a significant difference in the correct use of drugs and reducing

HbA1c levels in multimedia group. The results of the comparison showed that the experiment group had more knowledge; however it was not significant.²⁰

Numerous studies show that most diabetic patients have low or moderate level of knowledge⁴⁴⁻⁴⁶ and also lower-middle self-care.^{40,47-49}

One of the strength points of study was designing a software for the whole information needs of diabetes patients in a form of an integrated software which is applicable for other learners such as nursing students, nurses, patients' families and even for automatic display at therapeutic clinics on monitors and TV sets. Regarding the applied sounds, even illiterate and low literate patients could benefit due to the lack of facilities to be present in educational courses.

Since the participants of the present study were selected from among referring patients to diabetes clinic, therefore it was possible to have volunteer bias. On the other hand, all data were collected as self-reporting form. Then, it is possible not to reflect real functions of people.

Conclusion

In this study, training program was done to support multimedia software and in accordance with the findings of the research, the effect of interventions to increase knowledge and self-care of patients with diabetes was confirmed. It seems that the active role of patients in their care is the reason for this change. It is hoped that the ability to distance training attract the attention of policy makers and health care providers to use electronic management of chronic diseases.

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Ethical issues

None to be declared.

Conflict of interest

The authors declare no conflict of interest in this study.

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