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Evaluation of the effect of self-care education based on VARK learning style on HbA1c and FBS levels in patients with type II diabetes

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ABSTRACT

Background: Patients with type II diabetes mostly struggle with increased fasting blood sugar (FBS) and glycosylated hemoglobin HbA1c, which are associated with irrecoverable complications. Self-care education and different types of learning among patients are regarded as some of the most important issues in this regard. Therefore, this study aimed to evaluate the effect of self-care education based on VARK learning style on HbA1c and FBS in patients with type II diabetes.

Methods: This clinical trial was conducted on patients with type II diabetes referring to Parsian Clinic in Mashhad, Iran in 2015. In total, 72 samples were selected through randomized convenience sampling and divided into two control and intervention groups of 36 cases. Subjects of the intervention group were also divided into subgroups of visual, aural, read/write and kinesthetic based on the results of VARK questionnaire. Self-care education was carried out for the intervention group in two 60-minute sessions once every two weeks, tailored to learning styles of the patients. Meanwhile, routine conferences were held for the control group. HbA1c and FBS levels were evaluated in all the participants before and a month and a half after the intervention to assess the self-care of patients. Data analysis was performed in SPSS version 21 using Mann-Whitney U, Chi-square, independent t-test and Wilcoxon signed-rank test.

Results: In this study, mean score of HbA1c level was decreased from 7.7±0.8 to 7.0±5.7 (P<0.062), whereas mean score of FBS level was alleviated from 176.1±33.5 to 147.7±32.8 (P<0.001), which was only significant regarding the level of FBS (P=0.002).

Conclusion: According to the results of this study, application of VARK learning style led to a reduction in HbA1c and FBS levels, contributing to improved self-care in patients with type II diabetes. Therefore, it is suggested that learning style of patients be determined using VARK questionnaire before their education, which leads to providing education tailored to the needs of patients by healthcare members.

1. Introduction

Diabetes is the most common metabolic and endocrine disease,[1] associated with several healthcare problems, as well as physical, social and economic damages and, even, death. [2]

The world prevalence of diabetes has been estimated at 4.6 percent, and the number of people with diabetes is expected to reach 366 million by 2030.[3-5] In Iran, the prevalence of this disease has been reported between 8.3 to 2.10 percent with respect to different geographic areas.[6, 7]

Type II diabetes is the most common (more than 90%) form of diabetes, mainly accompanied with high fasting blood sugar (FBS) and glycosylated hemoglobin (HbA1c) levels, as well as chronic complications, including retinopathy, nephropathy and neuropathy. In addition, this disease could be the major cause of lower limb amputation and 2-4 fold increased risk of myocardial infarction.[8, 9] Early diagnosis of this disease and empowerment of patients regarding self-care behaviors through appropriate use of medication and lifestyle changes

can lead to reduced disease complications and improved life expectancy (up to 15 years).[10]

Self-care is a set of learned purposeful behaviors, which are basically performed by patients or their companions in accordance with real-life situation. In fact, patients with type II diabetes can select the most appropriate option based on their own background and culture in order to control their disease effectively.[11]

Self-care in patients with diabetes is of paramount importance since 95% of diabetes care is performed by the patient.[12] Some of the most important healthcare measures by diabetic patients are constant foot care, blood glucose control, insulin therapy, use of oral antidiabetics, physical exercise, adherence to a proper diet, lack of smoking and preventing chronic and acute complications of diabetes (e.g., hypoglycemia and hyperglycemia).[13- 15]

Several studies have pointed out the importance of self-care in patient with diabetes. In this regard, Delshad et al. (2016) identified lack of following the self-care principles as the most important cause of high mortality rate among patients with diabetes.[16] In addition, Ghirbani et al. (2014) recognized adherence to self-care behaviors to be the cause of 50 percent reduction in diabetes complications.[17] Saeedpour et al. (2013) also reported that self-care education could be a factor for improved general health and enhanced quality of life of patients with diabetes.[18]

Reliable indicators used to assess self-care status of patients with diabetes are normal levels of FBS (70-105 mg/dL)[12] and HbA1c (4-6%);[8] moreover, these indicators can help indicate mean changes of blood sugar.[6] High level of HbA1c is indicative of increased risk of microvascular complications. On the same note, 1% decrease of HbA1c level could be associated with 37% microvascular and 21% macrovascular complications.[5] Therefore, proper self-care education could improve the mentioned key factors, leading to enhanced overall health of patients with diabetes.[16, 19, 20] Nevertheless, the quality of self-care behaviors in patients with diabetes is extremely low in our country despite the technological advancements and provision of various educational methods in this area.[21]

Several studies have confirmed defects in performing self-care behaviors by patients.[12, 22] In this regard, Heerman et al. (2015) affirmed the undesirable status of self-care behaviors in patients with diabetes. According to the results of the mentioned study, patients with diabetes were not able to sufficiently perform self-care behaviors (e.g., diet, proper physical activity, blood glucose control, foot care, medication consumption and insulin injection), which could be the result of defects in the process of education.[23]

According to educational principles, the first step to successful training is recognizing the learning styles of students. Learning style is defined as a complicated method, through which students can efficiently understand, process and store information.[24-26] Therefore, successful and effective education is one adjusted to the learning style of students, which could be different for each individual.[27, 28] To adopt an appropriate perception toward different topics and contexts, education must be provided based on the preferred learning methods of students in order to exploit proper approaches and media for implementing education and stimulating students.[29, 30]

Flaming and Mills (1992) designed a pattern named VARK learning style, consisting of four visual, aural, read/write and kinesthetic subgroups. According to the mentioned researchers, visual people learn best through seeing shapes and forms. On the other hand, those with read/write learning styles learn through written and published literature. Auditory learners achieve the best education through listening and individuals with skills prefer practical work to learn and, at the same time, practice and experience in their field. Some people have multiple learning styles and could concomitantly use two or more abilities to learn.[31] Learning style must be emphasized as educational needs of patients since it has not been fully evaluated. On this theme, attention has been paid to students' learning styles only in classrooms and universities. Meanwhile, change of behavior happens when patients fully comprehend a topic, similar to students.[28]

With this background in mind, this study aimed to evaluate the effect of self-care education based on VARK learning style on HbA1c and FBS levels in patients with type II diabetes.

2. Methods

2.1. Design

This randomized clinical trial was conducted on patients with type II diabetes, covered by Parsian Clinic in Mashhad, Iran in 2015.

2.2. Participants and setting

In this study, Sample size for the HbA1c variable was estimated at 30 cases according to the study by Mazloom et al. (2015)[5] and mean comparison formula ($P=0.8$, $\sigma_2=1.4$, $\sigma_2=0.9$, $\delta_2=9.9$, $\delta_1=8.3$, $Z_{1-\alpha/2}=1.96$, $Z_{1-\beta}=0.84$, $1-\beta=0.8$), whereas the number of samples for FBS was calculated at 19 individuals based on the study by Grant et al.

(2004)[32] and sample size formula (σ_2=14.5, σ_1=2.6, δ_2=176.9, δ_1=165.3, $Z_{1-\alpha/2}$=1.96, $Z_{1-\beta}$=0.84, 1-β=0.8). However, with regard to sample loss, the final sample size was estimated at 36 patients in each group (72 in total) in order to have the minimum sample size and acquire valid information. Samples were selected through convenience sampling and randomly divided into two control and intervention groups of 36 cases. Random allocation was carried out by lottery, in a way that even days were assigned to the samples of the intervention group and odd days were allocated to the control group. Sampling process continued until both groups were completed.

Inclusion criteria were being literate, lack of vision and hearing impairments, diagnosis of type II diabetes by an endocrinologist at least three months before the start of the study, FBS level of 140-250 mg/dL, being within the age range of 18-65 years, no experience of acute stress (e.g., death of first-degree relatives) during the past six months, HbA1c level of 7-9% and lack of participating in special education programs regarding diabetes. On the other hand, exclusion criteria were travel or hospitalization during the study, experience of acute stress and absence from one of the training sessions. These data were obtained from medical records and through interviews with patients.

2.3. Instruments

Study tools were demographic questionnaires, laboratory information form, VARK questionnaire and an autoanalyzer. Demographic questionnaire included characteristics, such as age, gender, marital status, education level, smoking status, monthly income, number of family members, method of diagnosis, weight, height, number of hospitalization due to diabetes complications, duration of the disease and history of insulin use. On the other hand, the laboratory information form contained the results of 1 ml venous blood sample before and a month and a half after the intervention.

VARK questionnaire was first designed by Mills and Fleming at Lincoln and New Zealand universities and consists of four learning styles (e.g., visual, aural, read/write and kinesthetic). This questionnaire contains 16 multiple-choice questions with each alternative implying one of the learning styles.[31, 33] Each item assigns the learner with one learning style, and the respondent selects the alternative that best describes his performance in such situations. In addition, learners are allowed to choose more than one alternative if one option does not completely explain their situation. However, if none of the alternatives could imply the situation properly, learners could leave the question unanswered. In this regard, the first alternative is indicative of visual learning style, whereas the second, third and fourth alternatives demonstrate the aural, read/write and kinesthetic learning styles, respectively. After completing the questionnaires, the number of answers to each learning style was calculated and recorded in the scoring table in order to assess the final results. Patients could have one, two, three or all four learning styles. In order to determine learning style of patients, the total score was estimated after counting the number of each option (style), followed by the demonstration of learning style with the highest score. Smaller or equal numbers were assigned specific codes and recorded in the column of the least preferred styles.[34] It is noteworthy that reliability and validity of VARK questionnaire have been confirmed by Leite et al. (2010)[35] and other studies for the Iranian population.[36-39] In our research, reliability of this questionnaire was confirmed at the Cronbach's alpha of 0.89 using internal consistency.

An autoanalyzer with Acoplase model (made in Germany), along with Biosims kits (made in Japan) with 1.5% accuracy and Pars blood glucose test kit (made in Iran) with 4.5% accuracy were repeatedly used to evaluate level of HbA1c. In order to determine the reliability of study tools, ten blood samples were divided into two groups and were separately sent to the laboratory with different names at two times. Afterwards, correlation between the results was assessed and reliability was estimated at correlation coefficient of 0.99 All blood samples were preserved in similar conditions and all the tests were performed in one location by one laboratory expert.

2.4. Data Collection

Samples of the intervention group were required to complete the VARK questionnaire in order to determine their learning style, prior of the study. During this time, the researcher answered all the patients' questions. Necessary arrangements were made with the participants at the end of the sampling (one week before the intervention) in order to determine the time and conditions for participation in the research. Training sessions were performed in the diabetes center on even and odd days for the intervention and control groups, respectively. All of the participants were asked to fast at least 10 hours before the first session of sample collection (pre-test), and 1 ml/dL was obtained from all the samples by the researcher to measure HbA1c and FBS levels.

Moreover, training sessions were carried out in the form of two 60-minute sessions once every two weeks, during which the following subjects were

covered: 1) definition of the disease, 2) pharmacological and non-pharmacological treatment approaches, 3) identification of warning signs, 4) proper diet, 5) adequate physical activity, 6) method of insulin injection and related notes and 7) necessary recommendations in terms of blood glucose control.[19, 40-42]

Training sessions were designed based on learning styles of patients in the intervention group. In addition, teaching methods and aids, which were tailored to the patients' learning styles, were provided during these sessions (Table 1). The same learning contents were used to hold routine conferences for control subjects through dividing the patients into two groups of 17 cases. Time of pre-test was determined for both groups at the end of the training session. It is worth mentioning that necessary arrangements were made to remind the participants to attend the next meetings.

A month and a half after the training sessions, all the patients referred to the diabetes clinic to remeasure their HbA1c and FBS levels. Pre-test and post-test were performed at the time interval of nine weeks.

2.5. Ethical considerations

Written informed consents were obtained from all the samples in order to participate in the research in accordance with the approval of research ethics committee of Mashhad University of Medical Sciences. Research objectives were explained to the participants prior to the study and they were assured of confidentiality terms regarding their personal information.

2.6. Statistical analysis

Data analysis was performed in SPSS version 21 using descriptive indicators (mean and standard deviation), Chi-square test (to evaluate the differences between the intervention and control groups in terms of qualitative variables, such as gender, marital status, education level, smoking habit, monthly income, number of family members and method of diagnosis), Mann-Whitney U (for the comparison of differences between the intervention and control groups regarding abnormal qualitative variables, including age, number of hospitalization due to diabetes complications, duration of the disease, history of insulin injection and levels of HbA1c and FBS), independent t-test (to compare the differences between the intervention and control groups in terms of normal quantitative variables, such as weight) and Wilcoxon signed-rank test (for comparison of differences between abnormal qualitative variables before and after the intervention regarding mean HbA1c and FBS levels).

Table 1. Teaching methods of patients with diabetes based on VARK learning style in the intervention group

Learning style	Teaching method
Visual	Education was carried out through diagrams, PowerPoint, videos, concept maps, charts, shapes and symbols.
Aural	Patient encouragement for group reading, interaction with others, audio recording, review previous lessons, and use of acronyms. Recorded audio tracks were provided by the researcher at the end of each session to review the subjects.
Read/write	Participants were given 45 minutes to read the handout, list the important contents in the text and rewrite the text in their own way. At the end of the session, some of the patients were asked to read their written contents to other classmates. Therefore, lessons were reviewed and the researcher could answer patients' questions for 15 minutes.
kinesthetic	Role-play was used in this learning style through the selection of two patients (one in the role of a patient and the other in the role of a training nurse) to perform the education material.

3. Results

In this study, one and two samples were eliminated from the intervention and control groups due to acute stress and absence from the training sessions, respectively. Considering the sample loss, 69 samples remained in the study. With respect to learning styles, 10 patients had visual learning style, whereas 7, 13 and 5 patients had aural, read/write and kinesthetic learning styles, respectively. Other demographics of the participants are provided in Table 2. According to this table, no statistically significant difference was observed between the demographics of samples in both groups.

According to Table 3, mean level of HbA1c was significantly decreased in patients with various learning styles after the intervention. However, this decrease was only significant in patients with aural learning styles. In other words, the level of HbA1c was more decreased in patients with aural learning style, compared to the other participants (P=0.048). On the other hand, a significant reduction was observed in mean FBS level of all the participants

with different learning styles after the intervention (P<0.001). Nevertheless, the most amount of reduction in mean level of FBS was observed in the samples with aural learning styles.

Moreover, a significant decrease was observed in mean HbA1c and FBS levels after the intervention (P<0.0001), leading to a significant difference between the study groups after the intervention in terms of mean level of FBS (P=0.002) (Table 4).

Table 2. Demographic characteristics of the participants

Variable	Group	Interventic	Control	*P-value
		N (%)	N (%)	
Gender	Male	13 (37.1)	12 (35.3)	
	Female	22 (62.9)	22 (64.7)	*0.873
Marital status	Single	0 (0.0)	2 (5.9)	
	Married	33 (94.3)	29 (85.3)	
	Divorced	0 (0.0)	0 (0.0)	*0.276
	Widowed	2 (5.7)	3 (8.8)	
Education level	Primary school	11 (31.4)	11 (32.4)	
	Junior high school	9 (25.7)	7 (20.6)	
	High school diploma	8 (22.9)	11 (32.4)	*0.955
	Higher education	7 (20.0)	5 (14.6)	
Smoking status	Yes	3 (8.6)	3 (8.8)	
	No	32 (91.4)	31 (91.2)	*0.999
Monthly income	Sufficient	6 (17.1)	4 (11.8)	
	Insufficient	28 (80.0)	30 (88.2)	*0.748
	More than sufficient	1 (2.9)	0 (0.0)	
Diagnosis of the disease	Accidentally through blood tests	12 (34.3)	15 (44.1)	
	Through the incidence of disease symptoms	17 (48.6)	14 (41.2)	
	Through the incidence of disease complications	4 (11.4)	5 (14.7)	*0.505
	Others	2 (5.7)	0 (0.0)	
Number of family members	M±SD	4.2±1.6	4.9±1.7	**0.52
Age (year)	M±SD	50.9±9.3	53.4±9.7	**0.190
Weight (Kg)	M±SD	76.5±14.5	75.8±13.4	***0.838
Height (Cm)	M±SD	161.4±9.1	163.1±10.3	**0.5601
Number of hospitalization due to diabetes complications	M±SD	2.6±0.7	3.0±2.9	**0.491
Duration of the disease (year)	M±SD	11.1±7.7	8.6±6.0	**0.107
History of insulin injection (year)	M±SD	6.1±4.5	6.0±4.0	**0.0800

*Chi-square test; **Mann-Whitney U; ***independent t-test

Table 3. Comparison of mean HbA1c and FBS levels based on learning style of the samples of intervention group before and after the intervention

Learning style	Variable	HbA1c	FBS
		M±SD	M±SD
Visual	Before intervention	8.0±3.5	180.63±3.3
	After intervention	8.0±0.3	151.66±8.1
	*P-value	0.081	<0.001
Kinesthetic	Before intervention	7.0±4.7	170.12±1.5
	After intervention	7.0±3.0	142.1±9.8
	*P-value	0.141	<0.001
Read/write	Before intervention	7.0±7.3	171.13±6.5
	After intervention	7.0±5.6	144.17±4.8
	*P-value	0.116	<0.001
Aural	Before intervention	7.0±9.1	182.63±4.2
	After intervention	7.0±4.9	151.32±5.0
	*P-value	0.0486	<0.001

*Wilcoxon signed-rank test

Table 4. Comparison of mean HbA1c and FBS levels in the control and intervention groups before and after the intervention

Variable	HBA1C			FBS		
Group	Before intervention	After intervention	**P-value	Before intervention	After intervention	**P-value
Intervention	7.7±0.8	7.5±0.7	0.062	176.1±33.5	147.7±32.8	<0.001
Control	7.8±0.7	7.8±0.9	0.700	177.4±32.6	166.0±24.6	0.066
***P**	0.790	0.581		0.439	0.002	

*Mann-Whitney U; **Wilcoxon signed-rank test

4. Discussion

According to the results of the present study, self-care education based on VARK learning styles could improve HbA1c and FBS levels in patients with type II diabetes. While a significant reduction was observed in FBS level in all the learning styles of the intervention group, HbA1c level was significantly decreased only in patients with aural learning style.

In this regard, Salinero et al. (2011) concluded that self-management education tailored to the perception of patients with diabetes was associated with a significant decrease in HbA1c and FBS levels after a three-month monitoring program.[43] In addition, Duke et al. (2009) indicated in a review study that improved self-care in patients with diabetes could be a major factor for significantly decreased HbA1c and FBS levels during a two-month monitoring program.[44] Results obtained by Khandan et al. (2011) were indicative of significant impact of self-care education and intervention through follow-ups on improved FBS level and implementation of self-care procedures by diabetics.[45] Moreover, Farhandi et al. (2015) reported in a study that combined self-care education could be accompanied with alleviated HbA1c level and proper implementation of self-care to monitor blood pressure.[46] While the provided patient education in the mentioned studies was not directly based on learning styles of the participants, their final results are in line with our findings to some extent, with the exception of insignificant reduction of HbA1c level in the present research. This inconsistency between the results might be due to lack of blind trials, inadequate monitoring of medication use, lack of random assignment of patients to regular exercising regarding better influence of insulin and lack of strict adherence to the principles of self-control.

Hörnsten et al. (2008) demonstrated that education based on the perception of patients with type II diabetes led to a significant increase in HbA1c level in the intervention group, which is not in congruence with our findings due to differences in the monitoring time of HbA1c in both studies.[47] In a study by Hornstone et al. mean level of HbA1c was evaluated for six months, whereas the duration of the present study was six weeks.

According to our findings, the highest amount of change was observed in mean HbA1c and FBS levels of diabetics with aural learning style in the intervention group. Some of the main factors for reduced FBS and HbA1c levels were reading aloud, explaining to each other, asking from each other, audio recording and review of lessons as a teaching method. On this theme, Tan et al. (2015) recognized the conduction of a six-session self-care training program (in the form of conference, F&Q, discussion, and group reading sessions) to be the cause of significantly reduced FBS and HbA1c levels after three months of intervention.[48] The results of the mentioned study are in line with our findings only regarding the reduced level of FBS. This discrepancy could be due to differences in mean age of patients, which was higher in the current study. On this theme, aging is mainly associated with resistance to insulin due to loss of skeletal muscles, reduced glucose tolerance and elevated oxidative stress, which could be the cause of intervention inefficiency to change the level of HbA1c.

Results obtained by Jutterström et al. (2016) were indicative of the significant impact of self-care education on reduced HbA1c level after three months of intervention through group counseling.[49] Moreover, Kim and Kim (2013) reported that providing a self-management program through group discussion could result in enhanced self-care behaviors in patients with type II diabetes,[50] which is consistent with our findings. This consistency between the results might be due to family participation, presence of an advisory team (e.g., experts and nurses), interaction with other similar patients, encouragement of group reading, asking questions from each other and reviewing the lessons with other patients.

Contradictory results were obtained by Ko et al. (2014), who concluded that use of group discussion in training patients with type II diabetes could promote self-care behaviors.[51] This discrepancy could be due to differences in learning styles of the participants of the mentioned study.

One of the major drawbacks of the present research was the short period of monitoring of laboratory parameters. In addition, conduction of intervention in just one healthcare center and limited sample size led to difficulties in generalization of the final results.

5. Conclusion

According to the results of the present study, self-care education based on VARK learning style could be associated with decreased HbA1c and FBS levels in patients with type II diabetes. Moreover, the aural learning style was the most effective approach used to reduce FBS and HbA1c levels. Nevertheless, it is recommended that further studies be carried out on larger sample sizes and during longer monitoring periods to confirm the results.

Conflicts of interest

The authors declare no conflicts of interest.

Authors' contributions

Amir Reza Saleh Moghadam: Academic advisor, participation in the study design, revision of the manuscript. Farzaneh Hozhabr Araghi: Implementati on of training sessions, data collection, drafting of the manuscript. Hamidreza Behnam Vashani: Cooperation in study design, statistical consultation in research project, participation in drafting of manuscript. Hossein Karimi Moonaghi: Consulting advisor, monitoring the implementation of research. Ali Bazzi: Analysis and interpretation of data, acquisition of data, drafting of the manuscript.

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