Original Article

The Effect of Educational Intervention Based on the Trans Theoretical Model on the Physical Activity Level of Diabetic Patients in Iran: A Educational Trial Study

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ABSTRACT

Objectives: Regular physical activity can reduce mortality in patients with diabetes and prevent its complications. Planning to change behavior in these people in order to improve self-care is very crucial. The present study aimed to investigate the effect of an educational intervention based on the Trans Theoretical Model (TTM) on the physical activity level of diabetic patients.

Methods: In this educational trial study, 120 patients with type 2 diabetes were included in the study in Rasht city. So that they were divided into two groups of intervention (60 people) and control (60 people) using 2 random block methods, and they completed the questionnaires of physical activity and the constructs of the change stages model. Then the educational intervention, including lectures, pamphlets, and educational CDs, was provided to the intervention group, while the control group did not receive any education. After one month of follow-up, the patients completed the questionnaire again. Data were analyzed using SPSS.v20.

Results: The results showed that there was no significant difference between the intervention and control groups regarding regular physical activity before the educational intervention. However, after the intervention, the mean score of physical activity in the intervention group was higher than that of the control group, and this difference was statistically significant (P = 0.004). In relation to the distribution of physical activities change stages, a statistically significant difference was observed in the intervention group after the educational intervention ($p<0.001$).

Conclusion: The results showed that educating diabetic patients regarding physical activity based on the TTM was effective in progressing the behavior change stages and increasing the regular physical activity score of the patients. Therefore, it is recommended to design and implement educational programs to promote physical activity level based on behavior change theories in order to improve the control and management of type 2 diabetes.

Keywords: Physical Activity, Diabetes, Trans Theoretical Model, Educational Intervention

Introduction

Diabetes is a chronic, non-communicable, and serious disease that is predicted to be one of the major causes of mortality and disability worldwide in the next 25 years (1). This disease is one of the most important and common health problems in the world (2), so that according to recent studies, diabetes is the cause of about 4 million deaths per year (3). According to the latest statistics of the International Diabetes Federation, 436 million people in the world are living with diabetes, and it is estimated that by 2045, this number will probably reach 700 million people (4). According to this report, the highest prevalence of this disease in the ages of 40 to 59 years was in the Middle East and North Africa region with a rate of 10.9% (5).

Diabetes is spreading day by day. So that in 2010, its rate was 4.6% in adults, equivalent to 285 million people, and in 2012, it was about 371 million people, and it is estimated that it will reach about 552 million people by 2030. Also, studies state that the prevalence of diabetes in the Middle East region will increase significantly until 2030, and it is estimated that the annual growth rate of diabetes in Iran will reach the second place after Pakistan by 2030 (6). The rate of diabetes prevalence in Iran has been reported to be 23.9% (5). Due to the high rate of diabetic population in society and their special conditions, they need special care and attention (7).

Studies have shown that diabetes is associated with various disorders in the metabolism of glucose, protein, and fat (8) and causes major complications in most systems and organs of the body. As a result, it causes early or late complications of the disease, which then causes disability and high treatment costs and death. Also, a chronic increase in blood sugar causes destruction, dysfunction, and failure of various organs, especially the eyes, kidneys, nerves, and heart and blood vessels (9). Therefore, on this basis, many efforts are being made to achieve effective treatment measures to improve the metabolism of diabetic patients and prevent the complications caused by diabetes. Studies have indicated that diabetes and its complications, including eye, heart, vascular, and kidney complications, can be prevented by a healthy diet, regular physical activity, blood sugar control, blood pressure control, and blood cholesterol control (10).

Exercise controls blood glucose by improving the sensitivity of receptors to insulin secretion and thus reduces the need to take oral medications and insulin (10). Considering that muscle glycogen is burned during exercise and regenerated after exercise, this cycle of muscle glycogen depletion and regeneration leads to improved glucose tolerance and increased insulin sensitivity after exercise (11).

Exercise can improve the mood of diabetic patients by affecting blood circulation throughout the body and releasing endorphins. Also, it can control the risk of death by 21%, myocardial infarction by 14%, and microvascular complications by 37% in diabetic patients with a 1% decrease in glycated hemoglobin (12). Therefore, the American Diabetes Association and the European Association for the Study of Diabetes have determined that exercise is effective in controlling diabetes and reducing its complications (10).

Although the usefulness of physical activity in the control and management of type 2 diabetes has been well proven, studies show that people with diabetes have less physical activity than other people (13). Studies have shown that the level of physical activity in diabetic patients is lower than that of the general population, and one of the most important obstacles to physical activity in them is their lack of awareness and alertness regarding their sedentary lifestyle (14).

Accordingly, a sedentary lifestyle is known as a risk factor in diabetic patients, and the low level of physical activity can be a warning for health care service planners (15). In order to improve the lifestyle of people in the community, researchers believe that providing awareness about the risks and consequences of sedentary lifestyle is necessary but not enough. In addition, the classic interventions of health education are not very responsive, so it is suggested to use theory-based interventions with a clear framework (16). The most important and effective educational programs based on theory-based approaches are those that originate from behavior change patterns (7).

One of the models of behavior change is the TTM presented by Prochaska as a result of the review of various existing psychotherapy theories (17). The unique feature of this model is specifying the time dimension in behavior change, suggesting that people go through different stages during behavior change. According to this model, change is not an event, but a process, and people are placed in different stages of the behavior change process (7). Among the important constructs of this model is the pattern of stages of change, which focuses on understanding and predicting the destination of behavior (18). Studies have indicated that multiple exposure through a correct educational method, especially the TTM, is effective in increasing knowledge and self-care in diabetic patients (19).

The constructs of stages of change states that change occurs during 5 stages. These stages include pre-contemplation, contemplation, preparation, action, and maintenance. According to this structure, people need different interventions at each stage, and this grouping of people will enable them to use appropriate interventions according to the stages (16).

In this model, pre-contemplation refers to the stage where a person has not thought about changing or adopting a behavior, at least for the next 6 months. In the contemplation stage, a person thinks about changing behavior during the next 6 months, but is not yet fully

ready to act. In the preparation stage, a person seriously thinks about a behavior change and intends to make a change in the near future. In the action phase, the person has made appropriate changes in their lifestyle during the last month. In the maintenance stage, we can observe a longer period and strength of behavior change (7).

In the study of Motlagh et al., the results of the educational intervention based on the TTM showed a significant difference in the constructs of the change stages model, the process of change, and the duration of walking in patients with hypertension. Based on the TTM, a significant difference was observed for the constructs of the change stages model, change process, duration and power of walking in patients with hypertension. Based on this, educational interventions can improve physical activity, and education based on the model of stages of change had a positive effect on behavior and physical activity (20). Hajipour et al showed in their study that the educational program based on the TTM was significantly effective in increasing self-care behaviors and improving the glycemic index in the elderly with type 2 diabetes (21). Also, in another study conducted by Junsevg et al., the results showed that education based on the TTM can be effective in preventing stroke for people at risk (22).

On the one hand, the results of numerous researches confirm the role of educational interventions based on the TTM in creating behavior change in different groups of society. On the other hand, despite the growing number of diabetic patients and the occurrence of complications, few studies have been conducted on the effect of education based on the TTM among diabetic patients in Iran. Considering the above points, conducting the present study with the aim of determining the effect of education based on the TTM on the level of physical fitness of patients with type 2 diabetes referring to health centers in Rasht seemed necessary.

Methods

The current research was an educational trial study. It investigated the effect of the intervention based on the Trans Theoretical behavior change model on the physical activity level of diabetic patients referring to selected specialized clinics of the Gilan University of Medical Sciences.

The required sample size was determined with 95% confidence and 90% test power in the two-domain test of 48 people. This sample size was also determined based on the information in Table 3 in a study by Mousavi et al. (16) and using the mean and standard deviation parameters in this table. Finally, taking into account the 20% sample drop, the initial sample size was determined to be 61 people in each group. In this study, the total sample size included 122 patients who were selected considering the inclusion criteria. The study population also includes diabetic patients referred to Subspecialty Clinic of Beesat and Razi Hospitals in Rasht.

The inclusion criteria were the patient's active medical record and regular visits to the clinic; confirmation of the patient's diabetes by a doctor or the existence of evidence in their medical record; being in one of the stages of change, including pre-contemplation, contemplation and preparation, based on completing the questionnaire on stages of change; not having acute complications due to the disease; the ability to communicate verbally; not suffering from debilitating diseases; and willing to participate in the study. The exclusion criterion was unwilling to participate in the study.

In order to achieve research goals, valid and reliable questionnaires were applied, which was taken from a part of a tool used in a study by Mousavi et al. (16). The first part consisted of demographic information including 7 questions: age, gender, marital status, educational level, history of illness, occupation, and duration of diabetes. The second part was the questionnaire of the structures of the change stages model, in which the questionnaire of change stages was compiled based on physical activity in the form of 5 statements. "I do not intend to exercise regularly in the next 6 months, I intend to exercise regularly in the next 6 months, I intend to exercise regularly in the next 30 days, I have been exercising regularly for less than 6 months, I have been exercising regularly for more than 6 months." Answers to the question "Do you exercise regularly?" were examined and based on them, the samples were respectively placed in one of the stages of change (pre-contemplation, contemplation, preparation, action, and maintenance) (16).

The third part, the Global Physical Activity Questionnaire (GPAQ) was provided by the World Health Organization. This questionnaire calculates the level of physical activity based on the MET (Metabolic Equivalent of Task) scale, which is a unit scale to estimate the energy consumption of physical activity and is calculated based on the following formula (16).

(0 * times of light exercise per week) + (4 * times of moderate exercise per week) + (8 * times of heavy exercise per week) = Weekly sports activity score

This questionnaire has 16 questions related to the measurement of physical activity rate. This tool is actually another form of the International Physical Activity Questionnaire (IPAQ) that has been standardized for trans regional studies.

To determine the reliability of the tools, first, 12 diabetic patients among the research community were examined using this tool, and then Cronbach's alpha coefficient was used to determine the reliability of the internal consistency. The result indicated that the tool had internal consistency and was acceptable. In order to check the validity of the tool, the opinions of 8 members of the faculty of the Gilan University of Medical Sciences were used to determine the quantitative validity indexes of

Content Validity Ratio (CVR) and Content Validity Index (CVI), and the tool had high content validity.

In order to carry out the present research, after obtaining permission from the Vice-Chancellor of Research and Technology, it was presented to the research environments and data collection was done in the morning and evening work shifts by referring to the in-question clinics. In the first stage, the random block method was used to select the intervention and control group members. Then, after coordination with the specialist doctor of the clinic, immediately after each visit, the necessary explanations about the objectives of the research were presented to the patients. After obtaining informed consent, the questionnaire was given to the samples. In the next step, it was determined which stage of change, the person is in (determining the levels of the stages of change was done immediately by the researcher).

In case of placement in one of the first 3 stages (pre-contemplation, contemplation, and preparation) according to the mentioned sequence, the intervention strategy (presentation of educational contents) was presented to the samples in the form of educational interventions in the cognitive field, according to the stages of behavior change.

In order to carry out the present research, educational interventions based on educational goals were conducted as follows:

1. Providing solutions to increase physical activity (3 pamphlets containing solutions to this problem were provided).
2. Presenting the principles of physical activity in diabetic patients (1 guide manual including the principles of physical activity in diabetic patients was provided).
3. How to do all kinds of physical activities (1 guide manual including the principles of how to do all kinds of physical activities was provided).
4. Presentation of a sample walking exercise program for a diabetic patient (1 guide manual including a walking exercise program for a diabetic patient was provided).
5. How to perform physical activities (1 CD containing how to perform physical activities suitable for diabetic patients was provided).

In order to conduct the intervention and provide education to the test group, the educational intervention was presented in the form of a lecture in the first session. In addition, the researcher made phone calls with the samples once a week for 4 consecutive weeks and solved their problems through questions and answers, following up on reading pamphlets and books and watching educational videos. After 4 weeks, the questionnaires related to the stages of change and the level of physical activity were again given to the samples in the intervention and control groups to determine the impact of the interventions.

The data were entered into SPSS V.20 for analysis. Then, they were analyzed using statistical methods, including mean and standard deviation and inferential and analytical tests, including independent t-test, chi-square test, Fisher's exact test, Mann-Whitney U test, and Wilcoxon signed-rank test.

Results

The results of the research showed that the mean and standard deviation of the age of diabetic patients was 58.37±10.11 years, so that the youngest sample studied was 18 years old and the oldest was 84 years old. The majority of samples were more than 50 years old and only 13.33% of them were less than 50 years old. In general, 72.5% of patients were female and the majority were married (96.67%). The majority of patients have a diploma (56.67%) and about 62.50% had a history of underlying diseases other than diabetes. Most of the samples (62.5%) were housewives. The duration of diabetes in most patients was more than 10 years (41.67%). In this study, 2 of the subjects were not present in the second test and there was the problem of sample drop. This problem was due to death and lack of consent to continue participation (Table 1).

Table 1: Comparison of the frequency distribution of diabetic patients referred to the specialized clinics of the Gilan University of Medical Sciences according to individual occupational characteristics in the intervention and control groups.

Individual occupational characteristics		Group						P-Value
		Control (n=60)		Intervention (n=60)		Sum (n=120)		
		Numbers	Percentage	Numbers	Percentage	Numbers	Percentage	
Age (year)	50<	6	37.50	10	62.50	16	13.33	*0.265
	50-60	29	54.72	24	45.28	53	44.17	
	60>	25	49.02	26	50.98	51	42.50	
	Mean ± Standard deviation	59.8 ± 40.19		57.11 ± 33.70		58.10 ± 37.11		
	(most, least)	(45.0, 80.0)		(18.0, 84.0)		(18.0, 84.0)		
Gender	Female	45	51.72	42	48.28	87	72.50	0.540**
	Male	15	45.45	18	54.55	33	27.50	

Marital status	Married	59	50.86	57	49.14	116	96.67	0.619***
	Single	1	25.00	3	75.00	4	3.33	
Level of education	High school	23	54.76	19	45.24	42	35.00	0.030**
	Diploma	36	52.94	32	47.06	68	56.67	
	University	1	10.00	9	90.00	10	8.33	
History of diseases other than diabetes	Yes	44	58.67	31	41.33	75	62.50	0.014**
	No	16	35.56	29	64.44	45	37.50	
Job	Housewife	42	56.00	33	44.00	75	62.50	0.020***
	Self-employed	6	37.50	10	62.50	16	13.33	
	Employee	0	00	7	100.00	7	5.83	
	Retired	12	54.55	10	45.45	22	18.33	
Duration of diabetes	under five years	17	47.22	19	52.87	36	30.00	0.892**
	5 to 10 years	18	52.94	16	47.06	34	28.33	
	10 years and more	25	50.00	25	50.00	50	41.76	

* Independent T-test

** Chi-square test

*** Fisher's exact test

Table 2: Comparison of the frequency distribution of diabetic patients referring to the specialized clinics of the Gilan University of Medical Sciences according to the stages of change in physical activities before and after the intervention in the intervention and control groups.

Group		**Control (n=60)**		**Intervention (n=60)**		**Sum (n=120)**		**P-Value**
		Numbers	Percentage	Numbers	Percentage	Numbers	Percentage	
Changing physical activities								
Before the intervention	Pre-contemplation	42	56.76	32	43.24	74	61.67	0.189*
	Contemplation	5	22.73	17	77.27	22	18.33	
	Preparation	13	54.17	11	45.83	24	20.00	
	Mean ± Standard deviation	(1.0) 1.0 ± 52.83		(1.0) 1.0 ± 65.78		(1.0) 1.0 ± 58.81		
After the intervention	Pre-contemplation	37	78.72	10	21.28	47	39.83	0.001*<
	Contemplation	14	60.87	9	39.13	23	19.49	
	Preparation	7	29.17	17	70.83	24	20.34	
	Action	1	4.17	23	95.83	24	20.34	
	Mean ± Standard deviation	(1.0) 1.0 ± 53.77		(3.0) 2.1 ± 90.11		(2.0) 2.1 ± 21.18		
	P-Value	0.971***		0.001>***		0.001>***		

** Mann-Whitney U test

*** Wilcoxon signed-rank test

Table 3: Comparison of physical activity score and its changes in diabetic patients referring to specialized clinics of the Gilan University of Medical Sciences in control and intervention groups.

Group		**Control**	**Intervention**	**Sum**	**P-Value**
Total MET					
Before the intervention	Mean	2223.33	1000.33	1611.83	0.795*
	Standard deviation	4730.56	1447.26	3537.04	
	Median	340.00	480.00	420.00	
	Interquartile range	2340.00	820.00	1540.00	
After the intervention	Mean	1598.31	1871.53	1734.92	0.004*
	Standard deviation	3912.33	2221.51	3170.65	
	Median	40.00	1080.00	580.00	

	Interquartile range	1680.00	2480.00	1800.00	
	P-Value	0.001**	0.001>**	0.153**	
MET difference after and before the intervention	Mean	-658.64	870.51	105.93	0.001>*
	Standard deviation	2520.43	1464.13	2191.20	
	Median	0.00	360.00	0.00	
	Interquartile range	540.00	1560.00	560.00	

* Mann-Whitney U test

** Wilcoxon signed-rank test

Table 4: Comparison of changes in physical activity scores before and after the intervention in diabetic patients referred to the specialized clinics of the Gilan University of Medical Sciences in the control and intervention groups according to individual and social variables

Individual and social characteristics		**Group**						
		Control			**Intervention**			
		MET* total score difference			**MET** total score difference**			
		Mean	Standard deviation	Median	Mean	Standard deviation	Median	P-Value
Age	<50	-104.00	232.55	0.00	1398.00	2311.72	630.00	0.075
	50-60	-940.00	3523.74	0.00	1296.52	1470.30	840.00	0.001>
	>60	-443.20	805.41	-140.00	290.77	720.63	0.00	0.001
	P-Value		0.685			0.034		
Gender	Female	-444.09	896.55	-40.00	888.29	1504.09	120.00	0.001
	Male	-1288.00	4824.92	0.00	830.00	1410.04	390.00	0.015
	P-Value		0.413			0.980		
Marital status	Married	-667.24	2541.57	0.00	870.00	1490.88	250.00	0.001>
	Single	-160.00	.	-160.00	880.00	1020.59	840.00	0.500
	P-Value		0.814			0.910		
Level of education	High school	-316.36	643.94	0.00	882.22	1141.10	360.00	0.001
	diploma	-886.11	3184.19	-40.00	771.25	1559.09	60.00	0.001>
	university	0.00	.	0.00	1200.00	1787.20	480.00	0.600
	P-Value		0.661			0.650		
History of diseases other than diabetes	Yes	-688.84	2885.46	0.00	532.67	998.50	0.00	0.001>
	No	-577.50	1114.08	0.00	1220.00	1777.37	480.00	0.001>
	P-Value		0.844			0.198		
Job	Housewife	-421.95	906.67	0.00	911.88	1650.62	0.00	0.001>
	Self-employed	-580.00	1144.80	-40.00	796.00	978.24	660.00	0.022
	Employee	.	.	.	922.86	1863.99	420.00	
	Retired	1506.67	5377.13	0.00	776.00	1064.28	420.00	0.007
	P-Value		0.893			0.877		
Duration of diabetes	Under 5 years	-423.75	840.74	0.00	1109.47	1189.42	840.00	0.001>
	5 to 10	-704.44	925.47	-200.00	1170.67	2090.97	480.00	0.001>
	10 years and more	-776.00	3775.03	0.00	508.80	1153.81	0.00	0.007
	P-Value		0.317			0.181		

* Changes in the physical activity score (MET) before and after the intervention in the control group were negative and decreased.

** Changes in the physical activity score (MET) before and after the intervention in the intervention group were positive and increasing.

Table 2 shows the frequency distribution of diabetic patients, according to the stages of change in physical activities. The change stages of physical activity in the intervention and control groups were investigated before the educational intervention. The results indicated that out of 120 patients participating in the study, 32 people (43.24%) were in the pre-contemplation stage, 17 people (77.27%) were in the contemplation stage, and 11 people (45.83%) were in the preparation stage and none of the patients were in the action and maintenance stage. After the intervention, the results showed that in the intervention group, 10 people (21.28%) were in the pre-contemplation stage, 9 people (39.13%) were in the contemplation stage, 17 people (70.83%) were in the preparation stage, and 23 people were in the action stage (Table 2).

According to Table No.2, the rate of distribution of change stages in physical activities before the intervention was the same between the two groups and there was no statistically significant difference (P=0.189), but after the intervention, there was a statistically significant difference (P<0.001). This distribution before and after the intervention was not significant in the control group (P=0.971), but it was significant in the test group before and after the intervention (P<0.001). The mean and median of the change stages of physical activity also

increased from (1/0)1/65±0/78 to (3/0)2/1±90/11 in the intervention group.

Table 3 compares the physical activity score and its changes in diabetic patients in the intervention and control groups. According to this Table, the changes in physical activity scores before the intervention were not significant in two groups. But after the educational intervention, the mean score of physical activity in the intervention group was higher than that of the control group, and this difference was significant (P=0.004) (Table 3).

Based on the Table 4, the physical activity changes between the intervention and control groups by individual and social variables were significant in the majority of cases due to significant differences ($P < 0.05$). Only in patients less than 50 years old and unmarried people, despite the difference, it was not significant due to the lack of sufficient samples. However, changes in physical activity in terms of individual and social variables in both groups of control and the intervention were not significant in the majority of cases. Only in terms of age group in the intervention group, physical activity changes in the group of people over 60 years old were less than that of in the younger age groups ($P = 0.034$) (Table 4).

Discussion

The aim of this study was to determine the effect of an educational intervention based on the TTM in improving the physical activity of diabetic patients. In the current study, the distribution of the change stages in the intervention group increased significantly, and these results were consistent with the results of the study by Moeini et al. (23). In their study, there was no significant difference in regular physical activity before the educational intervention. But after the educational intervention, the change stages of physical activity in the intervention group increased significantly compared to the control group ($P<0.05$). Parhoodeh et al. (24) in their study also revealed that in the intervention group, the change stages of physical activity progressed towards the action stage, which was in line with the results of the current study. The study results of Lee et al. (25), which was conducted among middle-aged Korean women, also reported significant changes from the pre-contemplation stage to the maintenance stage, which was in line with the present study. The results of these studies and the present study confirm that an intervention based on a TTM can play an effective and positive role in the progress of physical activity changes.

In general, it can be concluded that based on this information, the distribution of physical activity change stages before the intervention was the same between the two groups and there was no significant difference. But after the intervention, this distribution had a statistically significant difference. The mean and median of physical activity change stages also increased statistically significantly in the intervention group. The results indicated that after the educational intervention, the intervention group compared to the control group had significant progress in the change stages, while no progress was observed in the control group. In a study conducted by Shirazi et al. (26), the results stated that after the educational intervention in the intervention group, there were significant shifts in the change stages. Therefore, the results of these studies indicate that education and intervention based on TTM can be effective for increasing the level of physical activity.

These results were consistent with the study results of Karimi et al. (7). With the difference that in the study of Karimi et al., six months after the intervention, the largest percentage of subjects were in the action and maintenance stage, but in the present study, no one was placed in the maintenance stage. This difference is probably due to the difference in the duration of the study and the target population.

The result of comparing the changes in the physical activity score of diabetic patients also shows the positive effect of education on the level of physical activity. Based on the data of the present study, the physical activity score before the educational intervention was the same in both groups and was not statistically significant. But after the intervention, the mean score of physical activity in the test group was higher than that of the control group, and this difference was significant. These results were consistent with the results of a study by Moosavi et al. (16). So that in their study, there was a statistically significant relationship between the mean and standard deviation and the levels of significance related to the level of physical activity in the intervention and control groups in the change stages immediately and six months after the intervention.

Also, the physical activity scores in the test group before and after the intervention increased by about 87%, which was statistically significant. These results were consistent with the results of a study by Moeini et al. (23), who used the measured physical power with a bicycle (Ergoline brand) to measure the level of physical activity.

In the study of Siregar et al. (27), the results showed that after providing the educational program of the physical activity, the level of physical activity in the elderly in the intervention group increased significantly. But no significant difference was observed in the control group. The results of these studies showed that the educational intervention based on the TTM can be effective in increasing the level of physical activity.

Conclusion

The present study revealed that the application of the TTM can be useful in improving the level of regular physical activity among diabetic patients. Also, this model provided a systematic framework for predicting behavior. Although diabetes is chronic in nature, many patients can control their blood glucose through regular

exercise and diet planning. Therefore, diabetic patients need to strengthen their knowledge and self-care skills. One of the methods of increasing self-care in patients is education about the techniques and interventions that patients do to control their disease and reduce its progress. On the one hand, inactivity is prevalent among patients, and on the other hand, based on studies, TTM-based educational programs have been effective on the physical activity level of diabetic patients. Therefore, it is suggested that the framework of educational materials be developed and presented to the patients in order to help the patients and their families. Also, according to the research results, the level of physical activity can be improved in diabetic patients by conducting educational interventions. As a result, it is suggested that in future studies, educational methods that are implemented using new technologies are used and its effect on the change stages and physical activity level of patients is compared with the effect of common old methods. It is also recommended that future studies be conducted in a larger statistical population in order to increase the generalizability of the research results.

Suggestions for future studies

It is suggested that researches in the future discusse assessing the role of physical activity in controlling the complications of diabetes.

Ethical Consideration

A letter of introduction was obtained from the university authorities after compiling the meeting minutes of the university research council dated 2019.07.20 and the approval of the ethics committee dated 2019.08.03 with the code number IR.GUMS.REC.1398.29 to be presented to the relevant officials in the research environment.

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Authors' contributions

This study substantial contributions to the conception design of the work MB and SM, the acquisition, analysis and interpretation of data MB and SM, KHJ ; the creation of new software used in the work SM, and KHJ; have drafted the work or substantively revised it MB and SM. All authors have read and approved the manuscript.

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Availability of data and materials

The data that support the results of this study are available by [Mahdie Bahrami] but there are restrictions on the availability of this data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of [Mahdie Bahrami].

Declarations

Ethics approval and consent to participate

The ethical principles observed by the researchers included obtaining permission from the Ethics Committee of Guilan University of Medical Sciences (code: IR.GUMS.REC.1398.29). In addition, written informed consent from all the participants were obtained and they were granted the right to withdraw Bahrami et al. The principles of anonymity and confdentiality were applied and the participants were provided with the results upon their request. This study has been approved by the Ethics Committee of Guilan University of Medical Sciences and all methods were carried out in accordance with relevant guidelines and regulations

Consent for publication

Not Applicable.

Competing interests

The authors declare no competing interests regarding the present study

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