Original Paper

The Effect of Training Based on James Brown Model on Self-efficacy in Adolescents with Type 1 Diabetes Mellitus

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ABSTRACT

Introduction: Type 1 Diabetes Mellitus (T1DM) is one of the most frequent chronic diseases among children and adolescents. Educational strategies underscore patient's roles in the management of diseases and enhance self-efficacy behaviors.

Objective: The purpose of this study was to investigate the effects of an educational intervention based on James Brown's model on self-efficacy in adolescents with T1DM.

Materials and Methods: In this randomized clinical trial, 70 participants were selected and assigned to the control and intervention groups by random block. The two groups received routine care for T1DM. The intervention group was also provided with educational sessions, 60 minutes twice a week for 4 weeks, based on the educational model. The participants completed the diabetes management self-efficacy instrument at the beginning, at the end, and a month after the end of the study. Data analysis was performed using the Chi-square, Independent samples t-test, Covariance (ANCOVA), and repeated measures ANOVA.

Results: The Mean±SD age of the intervention and control groups was 14.81±2.05 and 15.18±2.11 years, respectively. Before the intervention, the two groups were not different statistically in terms of demographic variables (age, sex, duration of diabetes, insulin intake, etc.) and self-efficacy. The results showed that immediately after the intervention and also in the follow-up stage, the mean scores of self-efficacies and its subscales (nutrition, blood glucose monitoring, physical activity, and medical treatment) in the intervention group were significantly higher than the control group ($P<0.05$). The mean scores of self-efficacies at the beginning, at the end, and a month after the end of the study were 27.97±5.08, 41.46±4.41, and 44.55±4.38, respectively. In the control group, however, these differences were not significant.

Conclusion: The education based on James Brown's model can improve self-efficacy among adolescents with T1DM. It is recommended that nurses use this method to increase self-efficacy in adolescents with T1DM.

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Highlights

- Diabetes mellitus is a chronic disease that affects patients' overall life.
- Education based on James Brown's model can improve self-efficacy among adolescents with type 1 diabetes mellitus.
- Educational strategies underscore patients' roles in the management of diseases and enhance self-efficacy behaviors.

Plain Language Summary

Type 1 diabetes mellitus is one of the most common chronic diseases of childhood and adolescence. Its peak incidence is around the ages of 5 to 7 years and adolescence. Diabetes mellitus is a chronic disease that affects patients' overall life. This disease is a self-management disease, meaning that the patients are responsible for most of their care plan. One of the most critical factors in the success of self-care behaviors in diabetic patients is self-efficacy. Educational strategies based on the model created by James Brown et al. have attracted the researchers' interest and are considered effective in improving patients' self-efficacy. Based on this model, learners are located at the core of the learning process, i.e., their characteristics, including their interests and capacities, are the critical components of education. The results of the present study showed that education based on the James Brown model increased the self-efficacy of patients with type 1 diabetes.

Introduction

Type 1 Diabetes Mellitus (T1DM) is one of the most frequent chronic diseases among children and adolescents. In recent decades, there has been a significant increase in the prevalence of diabetes worldwide, as 415 million people in the world are affected by this disease [1]. For example, in Iran, over 4.5 million people are affected by diabetes mellitus, and over 50000 patients are children and adolescents [2, 3]. Diabetes mellitus is a self-management disease, meaning that the patients are responsible for most of their care plan. Scholars believed that the main approach to blood glucose management and the prevention of disease complications is patients' active roles in their health care through self-care behaviors [4, 5].

Self-efficacy is the main factor related to self-care behaviors [5, 6]. Self-efficacy is a fundamental concept in Albert Bandura's social cognitive theory developed in 1997 [6]. Based on this theory, self-efficacy is an individual's belief in his/her ability to achieve goals through individual efforts [7]. Self-efficacy is a crucial factor regarding behavior change among diabetic patients [2, 8] and plays a vital role in the treatment of chronic diseases in general [9]. However, evidence indicates that self-efficacy scores are low to moderate among adolescents with T1DM [10].

In the modern management of diabetes, the patient oversees the disease and complication management, and healthcare professionals provide patient education to improve self-efficacy behaviors [11]. Educational strategies underscore patients' roles in the management of diseases and enhance self-efficacy behaviors. These efforts lead to healthcare cost-effectiveness, reduce hospitalizations, and prevent chronic disease complications [12]. Educational strategies based on the model created by James Brown et al. have attracted the researchers' interest and are considered adequate to improve patients' self-efficacy [12, 13]. Based on this model, learners are located at the core of the learning process, indicating that their characteristics, including their interests and capacities, are the critical components of education [13]. The emphasis in this model is on the identification and modification of learning groups, educational goals, education timings, teaching methods, educational environments, and the use of educational tools [14]. Some advantages of this model are the use of diverse methods of education, such as games, simulations, videos, and group discussions—compatible with the learners' interests. There is also a specific focus on the educational environment; for example, education is offered in recreational environments, such as parks [13, 14].

One study indicates that this model has positive effects on the knowledge and attitudes of patients with type 2 diabetes mellitus [15]. Another study showed that this model had improved women's experience about reproductive and sexual health [16]. In Iran, no pub-

lished research was found about training this model to enhance self-efficacy in adolescents with diabetes. Because self-efficacy in adolescents with type 1 diabetes has received less attention and this disease has adverse effects on the individual, family, and society, the current study was conducted to investigate the impact of education based on James Brown's model on self-efficacy in adolescents with T1DM.

Materials and Methods

This study is a randomized controlled clinical trial. This study was conducted in Diabetes Center, Kashan, Iran, from January 2018 to September 2018. Based on results of the study by Moein et al. (S1 and S2 were respectively equal to 14.49 and 17.1) [7], α and β were respectively equal to 0.05 and 0.2 with a type 1 error of 0.05 and a power of 0.85, and finally based on the Pocock's sample size formula [17], the number of participants in each group was estimated to be 32. Considering the 25% attrition, the final sample size for each group was calculated to be 40.

The inclusion criteria were the participants aged 13–19 years, had a definitive diagnosis of type 1 diabetes mellitus by an endocrinologist for at least six months, were not currently or previously participating in educational self-care programs based on the self-report of the patient and her/his family, did not have any other chronic or disabling diseases, and could independently complete the survey. The exclusion criteria for the participants were missing three or more educational sessions and diagnosis of other chronic or disabling conditions throughout the study. The participants were randomly assigned to the intervention (n=40) and control (n=40) groups by randomization block included 4 blocks of 10 (simple allocation using www.sealedenvelope.com) [18]. All participants voluntarily accepted to participate in the study.

The participants in both groups received routine care for T1DM. In addition to the routine care, the intervention group was provided with educational sessions. These sessions were held for 60 minutes twice a week for 4 weeks. Educational sessions were based on self-care behaviors grounded in James Brown et al. educational model [13]. A total of 8 sessions were held early in the morning on Mondays and Wednesdays in a Diabetes Center, Kashan City, Iran. It is noteworthy that the sessions were held in the summer season, and the adolescents did not have any educational activities at school at this time. The sessions were face-to-face and included group discussions and questions/answers between the first researcher and the participants. Educational materials that were used in the sessions included PowerPoints, videos, and pamphlets. Based on the model, 4 steps of addressing educational goals, educational conditions, educational resources, and academic outcomes were followed (Table 1).

The study measures included a sociodemographic questionnaire (age, sex, daily insulin intake, education, disease duration, treatment method, birth order) and the Diabetes Management Self-Efficacy (DMSE) instrument. The DMSE was developed, and its content validity was assessed by Bijl et al. (1999). The instrument is a 10-point Likert-type scale and consists of 20 items and 4 subscales. The subscales include nutrition (9 items), blood glucose monitoring (4 items), physical activity (4 items), and medical treatment (3 items). The total score ranges from 0 to 200. A higher score indicates a greater level of self-efficacy. Reliability for the instrument was reported 0.79 [19]. The Persian version of DMSE has been shown to have adequate reliability and validity by Haghayegh et al. [20]. In the current study, the tool's validity was confirmed through content validity and the approval of 10 experts in this field. In a pilot study of 20 diabetic adolescents (except the participants in this study), the Cronbach alpha was calculated in subscales between 0.86 to 0.90.

The first researcher contacted the participants in the intervention group twice a week to remind them to practice the trained activities and to answer their questions. The researcher's contact number was also provided to the participants. The researcher informed the participants to contact her if any related questions or concerns came up during the course of the study. Throughout the study, the control group only received routine care for diabetic patients.

Handouts consisting of the educational materials for the intervention group were provided for the control group's participants after the end of the study.

To answer the questions, in addition to the adolescents, the parents also completed the informed consent form. The survey was completed by the participants before, immediately after the last session, and one month after the intervention. A month after the intervention, the intervention and control groups' participants were asked to report to the Diabetes Center and complete the survey. The researcher contacted those participants who did not report to the center and scheduled to meet the participants at a convenient time and place to complete the survey.

Table 1. Content of training sessions

Sessions	Educational Content
First and Second	First step: Identification of educational goals This step included the introduction of the trainer, completing the participants' consent for participation, the definition of the disease and its subsequent complications and problems, completion of the study survey, questions and answers related to diabetic patients' educational needs, the motivation of the adolescent patients, and identifying the educational goals based on James Brown's model. Using the survey, the participants identified their educational goals, including their general, specific, and behavioral goals.
Third and Fourth	Second step: Identification of educational conditions Educational conditions refer to learning experiences, teaching and learning groups, and teaching methods. In this step, the focus was on training the participants regarding healthy eating, physical activities and their role in diabetes management, blood glucose monitoring, such as using a glucose meter, and other healthcare behaviors associated with diabetes, including insulin storage, insulin injection, and injection sites. This step was performed using games, simulations, and role models to the patient and a member of her/his family.
Fifth and Sixth	Third step: Identification of resources Resources include human resources, educational materials, and educational settings. This step was performed to accomplish the previous actions using multiple methods to enhance the education efficacy. The methods included lectures, educational videos, questions and answers, PowerPoints with educational pictures, color pamphlets with pictures, academic competitions, and awards. Due to the significance of the environment on learning enthusiasm, the educational program related to the importance of physical activity in the management of diabetes was provided in recreational centers such as a park.
Seventh and Eighth	Fourth step: Educational outcome The last step in James Brown's model refers to educational outcomes. The outcomes were evaluated, and the evaluation results were used as a basis for the modification of the intervention. In this step, the participants were assessed based on the educational programs classified in 1 to 3 steps. Based on the results of the evaluation, the participants' errors were modified.

In addition to adolescents, written informed consent was obtained from their parents. The normal distribution of the data and variables was verified by the Kolmogorov-Smirnov test. Continuous demographic variables were reported with mean and standard deviation and categorical demographic variables with frequencies and percentages. At the beginning of the study, the intervention and control groups were compared in terms of their sociodemographic characteristics using the Chi-square and Independent samples t-test. The repeated measures ANOVA was used to compare the mean scores of self-efficacy and its subscales at three time-points (before, immediately after the last session, and one month after the intervention). Analysis of Covariance (ANCOVA) was used to compare the mean scores of self-efficacy between the two groups. The statistical analysis was performed using SPSS for Windows, version 16.0 (SPSS Inc., Chicago, IL, USA), and the level of significance was set at 0.05.

Results

In the intervention group, 5 patients were excluded because of their absence in 3 or more educational sessions. In the control group, 5 patients were excluded due to a failure to complete the questionnaire at the end of the study. Thus, the study was completed by 35 participants in each group (Figure 1). The sociodemographic characteristics of the two groups are presented in Table 2. There was no significant difference between the two groups in terms of their sociodemographic characteristics. Table 2 is related to the results of repeated measures ANOVA in the intervention group and showed that the mean scores of self-efficacy and its subscales (nutrition, blood glucose monitoring, physical activity, and medical treatment) increased over the three time-points ($P<0.05$). Immediately after the last session and one month after the intervention, the Mean±SD scores of self-efficacy were 27.97±5.08, 41.46±4.41, and 44.55 ±4.38, respectively, and in the control group were 28.864±4.83, 29.1±4.9, and 29.37±4.61, respectively. The results of the ANCOVA test also showed that there

Table 2. Demographic characteristics of the intervention and control groups

Variable		Mean±SD/NO. (%)		Sig.
		Groups		
		Intervention (n = 35)	Control (n = 35)	
Age (y)		14.81±2.05	15.18±2.11	0.101*
Disease duration (y)		3.22±1.32	3.61±1.10	0.150*
Daily insulin intake (U)		54.6±5.18	52.4±6.23	0.255*
Sex	Female	17 (48.6)	16 (45.8)	0.974**
	Male	18 (51.4)	19 (54.2)	
Education	Elementary	2 (5.7)	1 (2.8)	0.920**
	Higher than elementary	33 (94.3)	34 (97.2)	
Treatment method	No Treatment	1 (2.8)	0 (0)	0.90**
	Insulin	34 (97.2)	35 (100)	
Birth order	1-2	25 (71.4)	26 (74.2)	0.914**
	3-4	10 (28.6)	9 (25.8)	

* The Independent samples t-test; ** The Chi-squared test.

was a significant difference (P<0.05) between the two groups' mean scores of self-efficacy (Table 3).

Discussion

The findings showed significant differences between the intervention and control groups in terms of their self-efficacy scores and its subscales over time (immediately after the last session and one month after the intervention). These findings indicated that the educational intervention based on James Brown's model effectively improved self-efficacy among the participants' disease management. Our results were in line with Reisi et al. [21]. They found that educational programs effectively improved self-efficacy and self-care behaviors among patients with type 2 diabetes mellitus. However, their educational intervention was not based on the model used in the present study.

Evidence indicated several interventions that may be positive in the improvement of self-efficacy among patients. Khavasi et al. reported that peer education positively affects type 2 diabetic patients' self-efficacy [22]. A study also found that education based on Bandura's social learning theory positively affected general self-efficacy and type 2 diabetic patients' self-efficacy [6].

Consistent with our findings, Ghazanfari et al. reported that an educational program based on James Brown's model positively affects knowledge and attitudes among patients with type 2 diabetes [15]. Also, research states that education based on this model improves the knowledge regarding reproductive and sexual health among women participating in marriage counseling programs [16]. Ayele et al. supported the significance of education in enhancing self-efficacy and self-care behaviors among diabetic patients [23]. A study also reported that education and counseling could improve self-care behaviors among patients with type 2 diabetes mellitus [24]. This consistency is that in all studies, items such as diet and physical activity, how to control blood sugar, and medical care have been taught in different ways, which is one of the subscales of self-efficacy. The studies are consistent in terms of the number of sessions and the educational content.

In line with James Brown's model, researchers believed that educational programs could be effective in patients with diabetes mellitus if they are planned based on spe-

Table 3. Comparison of mean self-efficacy score before, immediately after the last session, and one month after the intervention

Self-efficacy	Group	Mean±SD			Sig.*		
		Before the Intervention	Immediately After the Last Session	One Month After the Intervention	Time	Time x Group	Group
Nutrition	Intervention	43.31±10.28	70.45±9.14	72.34±7.20	0.001	0.001	0.001
	Control	45.5±9.1	46.32±9.3	46.81±8.9			
	ANCOVA		F=476.25 P=0.03				
Blood glucose monitoring	Intervention	24.81±3	37.81±3	38.10±2.87	0.001	0.001	0.001
	Control	23.90±4.41	23.90±4.41	23.43±4.18			
	ANCOVA		F=264.06 P=0.04				
Physical activity	Intervention	22.86±5.02	30.10±4.25	37.39±4.74	0.001	0.001	0.001
	Control	23.64±4.7	25.11±4.51	25.13±4.19			
	ANCOVA		F=254.7 P=0.02				
Medical treatment	Intervention	20.9±2.02	28.20±1.25	30.39±2.74	0.001	0.001	0.001
	Control	22.4±1.11	21.31±1.51	22.13±1.19			
	ANCOVA		F=201.32 P=0.01				
Total score self-efficacy score	Intervention	27.97±5.08	41.64±4.41	44.55±4.38	0.001	0.001	0.001
	Control	28.864±4.83	29.16±4.9	29.37±4.61			
	ANCOVA		F=189.95 P=0.01				

* RM ANOVA=Repeated Measures ANOVA.

cific goals and if learning objectives are defined with patients' and their caregivers' engagement [25-28].

The findings indicated that in the intervention group, the self-efficacy subscales (nutrition, blood glucose monitoring, physical activity, and medical treatment) were also improved over time (immediately after the last session and one month after the intervention).

Kazeminezhad et al. found that after education regarding self-care behaviors, the hemoglobin A1C and Fasting Blood Sugar (FBS) were significantly decreased [29]. Farmahini Farahani et al. reported that multimedia education effectively improves knowledge and self-care behaviors among women with type 2 diabetes mellitus [30]. Azizi et al. also indicated that education based on a self-care model effectively manages diabetic complications, medication use, and hemoglobin A1C in adolescents with T1DM [31]. Shabibi et al. stated that the education based on the health belief model was significant regarding improving self-care behaviors and nutrition, physical activity and exercise, and the management of early and late complications of diabetes [32]. These studies, like the present study, have used items that are important in the James Brown model, such as experiential learning, verbal encouragement, goal setting, and role-playing, the results of which are consistent with the present study. Sacco et al. indicated that phone contacts for a follow-up enhanced adherence to the exercise program, foot care, and nutrition modification among diabetic patients [33].

Several studies addressed effective educational and psychological interventions in diabetic patients. Their findings showed that the most effective educational methods related to self-efficacy in diabetic patients involve preset goals and is grounded in principles of empowerment and problem solving [34, 35]. Other studies indicated that education should be tailored to the patient's specific needs and conditions, including age, type and severity of diabetes, lifestyle, and culture [36-38]. These statements are congruent with James Brown's model. The International Society for Pediatric and Adolescent Diabetes (ISPAD) also supports these statements indicating that education of diabetic patients, especially children and adolescents,

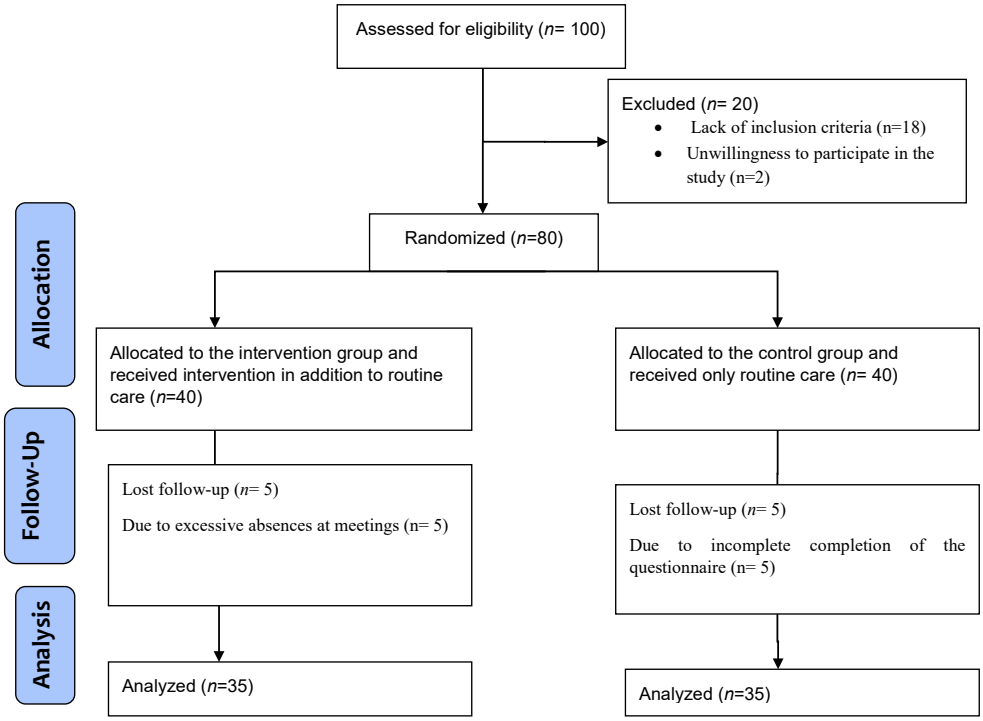

Figure 1. Sampling flow diagram

needs to be organized based on patients' attitudes, belief systems, preferred learning methods, capacities, learning preparedness, and goals [39].

The strengths of the study included the use of an educational model to increase adolescent self-efficacy and also to use games, simulations, and role models for the patient and her/his family education. This research was limited to the diabetic adolescents referred to a diabetes center in Kashan. Questionnaire completion based on self-reporting was another limitation of this study.

We found that education based on James Brown's model can improve self-efficacy among adolescents with T1DM. Considering the high prevalence of diabetes and its complications, healthcare researchers and professionals need to find strategies to integrate cost-effective and convenient interventions for improving evidence-based practice regarding the management of diabetes. We suggest education based on the James Brown model for improving self-efficacy among adolescents with T1DM.

al Considerations

Compliance with ethical guidelines

The Ethics Review Committee of Kashan University of Medical Sciences approved the study (IR.KAUMS.NUHEPM.REC.2018.032). The participants provided written informed consent and were informed of their right to withdraw from the study at any time. This trail was also registered at www.irct.ir (Trial Registration Number: IRCT20111210008348N39.

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Authors contributions

Concept and design: Zahra Yosefi, Neda Mirbagher Ajorpaz; Data collection: Zahra Yosefi; Analysis and interpretation of data: Neda Mirbagher Ajorpaz; Manuscript draft: Mohammad Afshar; Critical revision of the manuscript: Zahra Yosefi, Neda Mirbagher Ajorpaz, Mohammad Afshar; Final approval of the manuscript: All aythors.

Conflict of interest

The authors declared no conflict of interest.

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